THE

ELECTRICAL REVIEW.

VOL. LVIII. FEBRUARY 2, 1906. No. 1,471.

ELECTRICAL REVIEW.

Vol. LVIII.] CONTENTS: February 2, 1906. [No. 1,471.

	Page
London County Council (Electric Supply) Bill, 1906	161
Overhead Construction (*illus.*)	164
Correspondence	165
Our Legal Query Column	170
Legal	170
Business Notes	171
The Post Office Telephone System (*illus.*) (*concluded*)	179
City Notes	188
Electric Tramway and Railway Traffic Returns	190
Stocks and Shares	190
Share List of Electrical Companies	191
Proceedings of Institutions:—	
The Measurement of High Frequency Currents and Electric Waves (*illus.*)	193
Commercial Testing of Small Motors	194
Recent Advances in Wireless Telegraphy	195
Electric Winding Considered Practically and Commercially	195
New Electrical Devices, Fittings and Plant (*illus.*)	196
The Electrical Froissart Chronicles.—VI.	197
The Up-to-Date Engineer	198
Electrical Power in the American Navy	199
New Patents Applied For	200
Published Specifications	200

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone No. 933 Holborn; 4425 Central.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

BY FAR THE LARGEST CIRCULATION
of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free, per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 3s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE

UNIVERSAL ELECTRICAL DIRECTORY

1906 Edition

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

LONDON COUNTY COUNCIL (ELECTRIC SUPPLY) BILL, 1906.

THE London County Council recently put forward a memorandum in support of this Bill, in which the "*principal reasons*" which have "actuated the Council" are stated to be certain views which it says "are supported by the conclusions of the Select Committees of both Houses, who considered the Administrative County of London and District Electric Power Supply Bill of last Session," one of which is that if manufacturers requiring a supply for power cannot obtain it at prices consistent with modern developments, they will be placed at a great disadvantage in competing with rivals more favourably situated. The memorandum proceeds to say that "the Council has arrived at the conclusion that the needs of London . . . would be met in the most economical and satisfactory way by *its* being empowered to carry out" the scheme proposed in the above Bill, which it then proceeds to formulate.

Its Bill is of a permissive character, and provides for a supply to be given on terms of agreement only, yet it takes no power to supply manufacturers even by agreement.

And as to price of energy to those whom it can supply, although the Council "is in an exceptional position for affording such supply . . . the actual prices would, of course, depend upon the circumstances and requirements in each case . . . It can, however, at least be said that the Council's prices will compare favourably with the terms upon which a bulk supply could be obtained from any other source," for is it not "the intention of the Council . . . . to make only such charges for electrical energy as are necessary to make the undertaking self-supporting, including the provisions of an adequate reserve fund," and "broadly speaking," does it not "contemplate the sale of electrical energy at the lowest possible prices consistent with the safeguarding of the interests of the ratepayers"?

The area proposed is by no means limited to the County of London (about 117 sq. miles), but comprises parts of Essex, Kent, Surrey and Middlesex, "approximately 380 sq. miles." No wonder Lord Welby and the other members of the Finance Committee of the Council stood aghast, and were not to be appeased by the proviso to clause 36 of the Bill:—"Nothing in this Act shall authorise the borrowing and expenditure of any money on capital account after September 30th, 1907, or . . . of any greater sum than £425,000 before that date."

For though the Council stakes so much upon its exceptional position, it only supports that position by referring to the fact that it owns the tramways and is building a station to supply energy to those tramways. It puts itself under no obligation to supply energy to any local authority, company, body, or person, either at a maximum price or at all.

The clauses as to audit of accounts contained in the General Act are not to apply to the Council, and it takes

power to "make such charges against the revenue accounts of the tramway or electrical undertaking for energy supplied . . . as the Council may think fit."

The Bill also contains a clause for the revision of the prices charged by the Council thus: "The Council shall . . . reconsider and, if necessary, revise the prices charged (other that those contained in any agreement then in force) . . . so that, so far as is reasonably practicable, no charge shall fall upon the county rate . . . during the next three years." And, until the Council erect a generating station on the scheduled site, they may charge interest on borrowed moneys to capital account to the extent of £105,000.

There never was a Bill of which the nakedness was so completely shown up by the light thrown upon it by a memorandum circulated by its promoters. No obligation to supply; no fixed price; power to reconsider prices; no audit of accounts; power to charge another department of the Council what the Council thinks fit, &c. The County Council hardly seems to realise how much harm it is doing to its position and reputation by putting forward a scheme which has not been fully or seriously considered, and which, on the face of it, is merely a temporary expedient.

Though the estimated capital expenditure is stated in the preamble to be £2,500,000, the Bill, as already pointed out, prohibits any expenditure after September 30th, 1907, or of a greater sum than £425,000 prior to such date. But it takes two years at least from the passing of an Act to build and equip a generating station, so that even if the present Bill passes, say by August 1st, 1906, the Council cannot complete its generating station without coming to Parliament for further powers.

Truly an incomplete and ill-advised scheme, *par excellence*, although admittedly based upon one of the best prepared schemes ever submitted to Parliament.

On Tuesday the Council by 72 votes to 35 confirmed its November resolutions to proceed with the Bill.

The Position of Copper.

The position and prospects of the copper market are always of deep interest to electrical engineers, but more particularly so now—at the close of a year during which the price of the standard metal has touched £81, the highest figure since 1888, and has also fallen as low as £64. Within the past few days Messrs. J. Lewis & Son's annual report has been issued, enabling us to review the state of the world's markets, so far as is possible since the Amalgamated Copper Co. has ceased to publish details of its production. The total amount of copper manufactured last year is believed to have reached 672,000 tons, an increase of 67,000 tons over 1904. The United States make was about 413,000 tons, an increase of more than 51,000 tons, or about 14 per cent. over the previous year, this being about 61·5 per cent of the total. The importation into the States was 92,600 tons, an increase of 12,600; and the exportation from the States was 245,500 tons, a decrease of 7,500. Australia sent 4,700 tons more to Europe than in 1904; the Cape sent a slightly smaller quantity; the importation from Japan fell to practically nothing. The exportation from Peru increased by 1,870 tons, and that from Mexico by 1,690 tons; but Spain and Portugal provided 3,700 tons less. Altogether the amount of copper received in Europe during 1905 was 45,400 tons less than in 1904, 43,264 tons of the deficiency being due to the States, whose spare metal was largely absorbed by China. The consumption in the States is estimated to have risen from 186,430 tons in 1904 to 268,400 tons in 1905—an increase of 82,000 tons, or 44 per cent. Hence, in spite of the larger output and importation, the stocks at the close of the year in the States were only 59,000 tons, 8,200 tons less than last year.

According to Messrs. Lewis, there was an apparent decrease of about 52,500 tons in the European consumption; Great Britain being responsible for 24,500 tons, France for 10,400 tons, Germany for 9,400 tons, and Italy, Austria and Russia for about 5,000 tons of this falling off. Actually, however, there was an undoubted increase in British consumption, and perhaps in German also; the deficiency being made up by a withdrawal of at least 50,000 tons from European stocks. These latter, as held both by manufacturers and consumers, are now at an almost irreducible minimum. The amount of manufactured copper exported from England was about 800 tons, and of unmanufactured metal 14,760 tons more than in 1904; 11,500 tons went to the States, and a good deal to China.

The feature of the past year, and, according to Messrs. Lewis & Co., the cause of the advance in prices was the sudden demand for copper in China. The authorities of that land became possessed with the idea that they could literally "make money" by impressing copper disks with appropriate devices. They therefore increased the capacity of their existing mints and gaily erected new ones until, outside four provinces of which no information is published, they had 846 stamps ready for work or in process of construction. Then they purchased about 50,000 or 60,000 tons of copper (about 42,000 from the States), and started converting it into 10-cash pieces. The game seems still to be profitable, although the exchange value of the cash has already fallen 25 per cent., and it is said the coinage will bear a further fall of 50 per cent.; but representations have been made by Baron Mumm von Schwartzenstein, *doyen* of the diplomatic body at Pekin, on behalf of the Shanghai General Chamber of Commerce to the Government, pointing out the evils which inevitably follow on such wholesale debasement of the currency. Meantime a considerable quantity of the copper sent to China has been resold to the United States and Europe at prices leaving a comfortable profit.

Prevision of the future is greatly obscured by the Chinese position. Messrs. Lewis seem to anticipate that China will throw the surplus metal she holds on the market, but other writers think that if a drop in the price (say of £10) should occur, she might buy more, and go on with her "smashing." Apart from this, the United States output will probably increase at least 15 per cent., and that of Mexico, Australia and Japan be stimulated by the high prices now prevailing. These prices tend to restrain the use of copper sulphate, and of the metal itself in certain directions. On the other hand, considerable additions are being made to the fighting and mercantile ships of the world, as was the case last year, when the I.H.P. of the marine engines constructed reached 1,502,000 H.P., against 1,339,000 in 1904. The electrical and engineering trades are also busy, and there are signs of a comprehensive revival in commerce and industry. The general notion seems to be that prices will remain fairly firm during the first few months of 1906, owing to the smallness of the European stocks, but that later on increased supplies may bring about a certain amount of fall.

Wireless Telegraphy on the River Amazon.

We are enabled to give the following particulars as to the working of the Fessenden system of wireless telegraphy on the River Amazon during the early part of last year. The stations selected for the trial were Pinheiro, distant about 10 miles from the city of Para, or Belem, and the small village of Breves, situated in what is called the Narrows, a network of waterways among low-lying densely-wooded islands between the Para River and the main stream of the Amazon. The distance between the two stations is somewhere about 100 miles measured in a direct line.

The erection of the former station was begun on November 22nd, 1904, and of the latter on December 4th. Both stations were complete on December 29th, and attempts to exchange signals were begun on that date. Considerable delay and difficulties arose from the extreme damp necessitating increased insulation to prevent all-round leakage, and it was not till February 5th, 1905, that faint signals were received from Pinheiro, and these during the night.

On February 18th the word Breves was received at 6 p.m. More delays occurred through alterations to the outside system, and also through the ill-health experienced by the engineers, which obliged a voyage to Barbados for recruiting purposes. Out of eight of these gentlemen, each and every

one was attacked by malarial fever if he remained at Breves longer than a fortnight.

June 5th saw the first message of 20 words successfully sent from Breves to Pinheiro, whence it was forwarded to Para by the Amazon Telegraph Co.'s cable.

From June 18th onward it is stated that communication was maintained day and night, and on July 25th a public demonstration was given, and greetings were exchanged all day between a number of prominent residents of Para and Breves and representatives of various newspapers.

In addition to these two stations, three others seem to have been established between Breves and Manaos, and, after a trial of several weeks, the Wireless Co. were so satisfied with results that they paid for the apparatus in full, and arranged to move their terminal station from Pinheiro to an expensive site at Para. Before this was done, however, a decision was reached by the Supreme Court of Justice at Rio Janeiro, which decided that the concessions held by the Wireless Co. for work inside the States of Para and Amazonas did not confer upon them the right to work between the States, it being the Federal Government only who could grant this. The Supreme Court went on to say that if anyone should have the right, it should be the cable company.

This decision was, of course, a perfectly fair and reasonable one, considering that the Amazon Telegraph Co. were granted a concession giving them a monopoly, and was only to be expected, since, at the expiration of the concession, all the cables, ships, stations, instruments, &c., become the property of the Brazilian Government.

Why the report from which we obtain the details we give as to the working of the wireless system does not give fuller information, it is hard to understand. When will those connected with wireless telegraphy appreciate that one of the reasons why there is such a general want of confidence in them is because instead of definite facts, general statements only are made? When a submarine cable is completed, it is carefully tested, and the results show absolutely its capacity for work. With wireless telegraphy one can only judge from the actual results, and the successful transmission of a few short messages during a day in no way warrants the assumption that the working was at a reasonable speed and continuous, however satisfactory it may appear from an inventor's point of view.

It is possible that "wireless" may be very useful as a second string, now that the successful maintenance of the Amazon cables has resulted in the development of a large volume of traffic, and if by its means communication is possible between Para and Manaos, with Santarem as an intermediate station, no doubt much useful work could be carried out at times when there is a rush of traffic or when there is an interruption to the cable. The Amazon Telegraph Co. should be prompt to take advantage of the situation, and start wireless telegraphy on their own account, if for no other reason than to make certain that others do not secure rights which may become of the greatest value as the "wireless" system develops. They will only have themselves to blame if, through their want of enterprise, they suffer at some future time from the competition of wireless telegraphy.

A Curious Specification.

Our readers will remember that, some years ago, under the heading "Current Specifications," we criticised more than 100 of these documents, with a view to correcting, or at least mitigating, the abuses of authority which were so frequently perpetrated by municipal authorities in their specifications. We feel called upon to revert to the subject this week by the issue of a peculiarly flagrant example, which unfortunately only came under our observation within the last few days; the tenders were opened on Tuesday last, but we trust it is not too late to draw attention to the extraordinary conditions imposed upon tenderers.

We refer to the specification for the Overhead Equipment of the Leyton U.D.C. Tramways, issued by the Council's electrical engineer, Mr. F. Harman Lewis. It is herein specified that the pole bases, collars and finials are to be of the design of the sample deposited at the Council's electricity works, and must be obtained by the contractor from the A . . . . Co. at a price of 17s. per set. In connection with the line material, the insulated bolts are to be of the manufacture of the B . . . . Co., from whom the contractor is to obtain them; the same stipulations are applied to the spherical strains and Brooklyns. Again, the section insulators are to be similar to sample, and are to be obtained from the C . . . . Co., to whom also the orders for frogs and crossings, and movable points, must be given. Lastly, the switch pillars, and the switch and fuse boxes, must be obtained by the contractor from D . . . . Co. at stated prices.

It is within the right of the engineer to insist the material supplied being up to a definite standard, but we strongly protest against the allocation of orders in this way to stated firms. The local authority is compelled to put up the work to public tender; but under the conditions described above the process is a mere farce. Not only are the manufacturers named, in spite of the fact that other makers of equal eminence, the quality of whose work is unquestioned, are ready and able to supply the materials, but even the prices are specified, which, we believe—in some cases, at any rate—are far above the prices ruling in the market for similar material.

We consider that the affair is extremely unsatisfactory. We strongly urge the Urban District Council of Leyton to take the whole matter into consideration, and to institute an inquiry into the reasons why certain firms and prices are specified, and into the circumstances under which the specification was drawn up.

Engineering in the U.S. Navy.

Although at the present moment it is somewhat too early to pronounce a definite opinion as to the success of the change which has led to the reconstitution of the *personnel* of the British Navy, it would appear that the adoption of "common entry" and subsequent "specialisation" has, at any rate, solved for us the main difficulties of the problem, and that the ultimate effectiveness of the scheme will depend solely upon the degree of prudence evidenced by my Lords in determining the conditions, period of duration, and thoroughness, of the engineering specialisation. Meanwhile it is instructive to observe what is transpiring on the other side of the Atlantic, and to note the straits in which the U.S. Navy finds itself for lack of proper provision for the training of the engineer officers and ratings of the engineer branch. It will be remembered that in the year 1899 the corps of engineer specialists in the U.S. Navy was abolished, their duties being taken over by what they term the "line" officers. A recent report, published by the Chief of the Bureau of Steam Engineering, points out that the original intention was that all the younger officers of the Engineer Corps should perfect themselves in seamanship, gunnery and navigation, and that younger officers of the "line" were to perfect themselves in engineering, so that subsequently all should reach a general purposes standard. For three years nothing was done by these officers towards acquiring engineering experience, except that a few of them by their own exertions acquainted themselves sufficiently with engineering duties to enable them to serve with marked efficiency in responsible steaming duties afloat. Now, the older engineer officers are rapidly disappearing, and so few officers of the "line" are taking up engineering duties that the Chief of the Bureau confesses alarm. He insists that if the "line" officers are to become good engineers they must be given practical experience, such as can be acquired only in subordinate positions under competent engineers of the fleet, and he protests against the formation of a separate corps of engineers. This is scarcely the place to discuss the question in detail, but indirectly it is a matter of supreme importance to engineers, electrical and otherwise, in this country. The failure of the United States scheme is an object lesson which it would be conspicuously unwise for those interested in the British Navy to cast lightly aside. If the "common entry" and "specialisation" scheme, which has saved us from the defects of the American *en tout cas* arrangement, and from the perils of a separate corps of engineers, is to be worked out with complete success, every phase during the next few months of its development must be regarded with care by engineers competent to judge of the high standard of training necessary for those to whom are to be entrusted the forces and agencies of our material fleet.

D

OVERHEAD CONSTRUCTION.

By A LINEMAN.

Although I am unable to speak for the rest of the world, still I should have expected Mr. Tweedy, if he has any strong belief in his own facts, to have betrayed some astonishment when an attempt was made to impugn them. The only conclusion one can come to is that his knowledge of his own facts is very limited, and he is, therefore, not astonished to find them controverted.

I am quite prepared to admit that the proposition of a perfectly smooth path, being that which will cause the least possible wear both to itself and that which moves over it, sounds reasonable enough as a general statement, and would be quite applicable to the case of the trolley wheel running on the trolley wire provided the flexibility of this

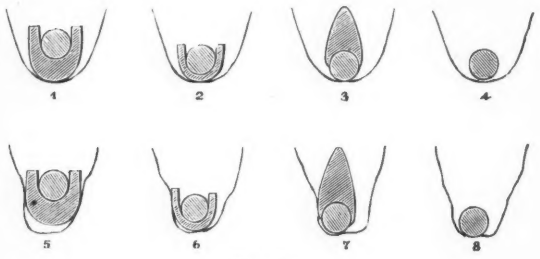


Fig. 1.

was the same at the points of suspension as it was between these. Mr. Tweedy credits me with saying that the least wear occurs where this path is protected by a break in its smooth regularity, and that my experience proves how injurious it is to try to prevent this. The misinterpretation is utter nonsense and obviously intentional. What I did say was that "since we cannot do away with the wear we must do something to protect the trolley wire where this (the wear) is greatest, viz., at the points of suspension; and I said this after stating my experience with a perfectly smooth path which three years ago I would have agreed was the remedy. The corrugated wear which I mentioned, is found at all points of suspension irrespective of type of ear, and whether the trolley wire be circular, grooved, or figure-8, and is, after all, the only wear of importance which does occur on lines where the ears are of good design and have been properly erected. The cause of this is undoubtedly the pitching motion of the single bogie cars and the consequent vibration of the trolley springs; and, moreover, the more rigid the suspension, the more irregularities in the track, and the higher the speed at which the cars travel, the greater is the wear. The speed, however, is not necessarily less on up-grades than on down-grades, where greater care on the part of the motorman is required. On lines where the gradient is, say, about 1 in 20, quite the reverse is the case. This greater speed, together with the increased rigidity and more acute pitching of the cars, is the cause of the excessive wear on the up grade. The absence of similar wear on the down grade is explained by the fact that the cars glide slowly down with front springs compressed, and with a minimum of pitching. On the other hand, where the gradient is, say, 1 in 70, the proportion of wear is generally greater on the down grade, as the cars can travel with safety at a higher rate of speed, and the pitching motion is thereby increased. This greater wear should not, however, be considerable if the method of suspension is flexible, and flexibility increases as the gradient decreases.

Mr. Tweedy says, "One does not look for the trolley wire to be worn dangerously where it is clasped by a deep-grooved ear." This is exactly my contention; and in my long experience of wear on trolley wire and ears, not one single instance of the trolley wire snapping at the end of an ear has come under my notice, and, considering that on some of the routes the number of cars using the ears is over 100 per hour, it will be seen at once that there has been ample opportunity for such a complaint to develop had it cause to do so.

"No shallow-grooved ear in use to-day was so dimensioned when new that it did not overhang the vertical tangents to the circle of the wire," nor is there any trolley wheel in use to-day which is at any time in contact with half the circumference of the trolley wire. The two areas of contact made at the ear will be found to be as great, and very often greater, than the one area at which contact is made when the wheel is on the wire, and they are at all times more than sufficient to carry the current necessary to drive the car up the steepest gradient. "Arcing" takes place only when the contact is broken. The U-shaped wheel used on the system here is somewhat different from those of the more common V-shaped, and in itself disproves the "arcing" theory, as with it there is always a greater contact area on the ear than on the trolley wire. Any evidence of arcing, other than that which is caused by the flanges of the wheel coming in contact with the thickened part at the centre of the ear, will be found on the ridges and not on the hollows of the corrugations, which proves that this is due to the pitching motion of the single bogie cars, and the consequent oscillation of the wires.

In fig. 1, No. 1 illustrates this wheel when new, on a section of a new under-running mechanical ear. This section is heavier than what would be absolutely necessary, but it increases the working life of the ear, which tapers to a knife edge at each end. No. 2 illustrates the same wheel on a section of a worn mechanical ear of the same type, and the amount of wear is worthy of note. No. 3 illustrates the same wheel on a new soldered ear, to which I have already referred, and although for convenience I called it a shallow grooved ear, I did not intend it to be mistaken for the hideous thing commonly used. It was as near as possible Mr. Dudgeon's ideal, and so far as providing a perfectly smooth path was concerned, it was all that could be desired. There was absolutely no fouling of the sides by the wheel, for, after having been in use for several months on a part of the system where there is a heavy service of cars (125 per hour) the ears were almost the same as when erected, whereas the wire under

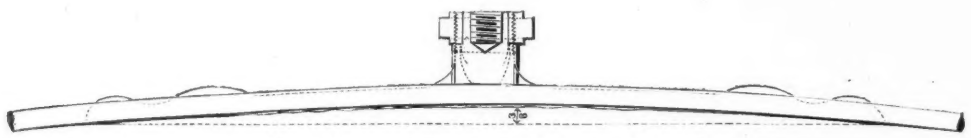


Fig. 2.—The Dotted Line shows the Original Size; Wear, $\frac{3}{8}$ in.

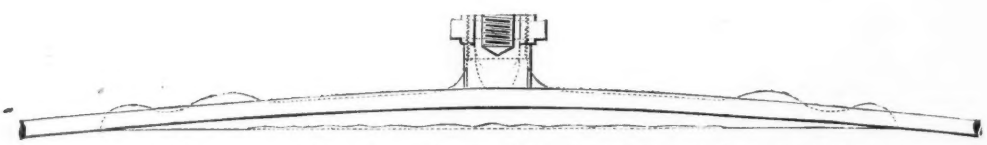


Fig. 3.—Original Size shown Dotted; Wear, shown by Full Line, = $\frac{1}{32}$ in.

them was worn to one-third its original diameter. No. 4 illustrates the same wheel on trolley wire, and here it will be observed there is a minimum of contact. Nos. 5, 6, 7 and 8 show the same ears and trolley wire on a worn wheel of the most common type.

Mr. Dudgeon's figures are of no value, as they show that he has not experienced sufficient wear to enable him to speak with authority. Such little wear as he has experienced, is not to be compared with the wear of which I have been writing, and would not be cured by double bogie cars, as it is mainly due to faults either in the ears themselves or in the method of erection. It could easily be overcome by his taking precautions to see that no roughness is left on any ears which he may have occasion to erect, and by the vigorous application of a file to those recently erected.

That rigidity and the pitching motion of the cars have everthing to do with heavy wear, figs. 2 and 3 corroborate, and by rigidity I mean the resistance offered to the trolley pole. Fig. 2 shows the wear on a longitudinal section of a mechanical ear which was attached to a centre pole with a flexible span 3 ft. long. Fig. 3 shows the wear on a longitudinal section of the same type of ear attached to a flexible span 80 ft. long. These ears were 12 months in use on a comparatively level line where the average number of cars passing under was 125 per hour, and, save for the difference in the method of suspension, the conditions were the same, and they are not in any way exceptional specimens. Mr. Dudgeon says, "If there was anything in "Lineman's" theory, then the wire near the ears would show much more wear." How he arrives at this conclusion I cannot imagine, since it is outside the region of rigidity, unless the ears be very short, when wear will be found to extend some distance outside of the ear at both ends. This I experienced with grooved trolley wire and 6-in. ears, which goes to prove that bumping has nothing to do with the wear, provided the ears are of good design and have been properly erected. With ears of the usual length, this outside wear would undoubtedly take place if they were suspended at both ends, and not merely at the centre.

It is quite to be expected that an ear riding free on the wire should show some wear, since when the wire is forced upwards by the trolley pole, the ear does not remain in a vertical position, but falls to one side, and "bumping and arcing" wear results.

Rigidity has so much to do with the wear that even the weight of overhead fittings has an influence upon it, for most wear will be found where these are heaviest. Section insulators show the most wear, and on up-hills it is proportionate to the wear on ears. This could not be so if "arcing" was the cause of the wear, as no arcing of any importance can take place at a section insulator. Feeder ears when the cables are carried to the trolley wire on the same span on which these are suspended, come next in order of wear, after them anchor ears, to which anchor wires are attached, and finally straight line ears.

Mr. Dudgeon remarks that the system on which he is employed is older than Glasgow. Although he does not say so, I think I am entitled to assume that he is employed on the Dudley and Stourbridge Tramways. The date of opening in Stourbridge was July, 1899, while in Glasgow it was October, 1898, and in that case he is in error in claiming that his system is older than Glasgow. He surely knows, however, that it is not so much by the length of time that the ears and wires are in use as by the number of cars using them, that their working life is estimated. In this respect, also, Glasgow has had greater experience, as here there are 692 cars to 147 miles of track, while in Stourbridge there are only 59 cars to 27·22 miles of track.

"It will, I have not the slightest doubt, surprise many to learn that great differences in the pressure of the trolley wheel against a wire which is truly central to the track have little or no effect either way on the wear of the wire," and that surprise is so great that it will require more proof than Mr. Tweedy brings forward, before it can be believed. Here let me point out that while "the nominal pressure may not be in excess of 18 to 25 lb.," still with the pitching motion of the car, and the consequent oscillation of the wires, the actual pressure may be anything from 1 to 100 lb.

Mr. Tweedy says, "no one should arrogate the power to prove conclusively any point in argument as affecting all systems, when the material of proof is derived from a comparatively small number of observations made over a comparatively short length of track." With this I quite agree, and when it is borne in mind that the observations on which his statements are based, appear to have been made on an insignificant length of track, his remarks may very well apply to his own case.

Notwithstanding what Mr. Tweedy has said, it is not fairly evident that the cause of the wear is different on up-hills from that on down-hills and levels. I maintain, and have, I hope successfully, attempted to prove, that it is the same in both cases, and that a perfectly smooth path for the wheel, such as would be presented by figure-8 wire, will not do away with this unavoidable wear, although, undoubtedly, it would do away with the wear of which either badly designed or carelessly erected ears are the cause.

Mr. Dudgeon has offered no reason why my views regarding his knowledge of overhead equipments should be modified. On the contrary, had he been endeavouring to justify these, his efforts would have been rewarded with a fair measure of success. When one is writing on a technical subject, one pre-supposes an average amount of intelligence in one's readers, and hence one does not explain the obvious. When I said that on uphills "the rigidity is greater," I did not think that such an obvious fact called for any explanation; and if Mr. Dudgeon cannot understand why it is so, then I do not consider it is for me to enlighten him.

The wear, as I have said, and as most linemen know, cannot be cured; it must therefore be endured, and the only course left is to lessen the effect from an economic standpoint. This can alone be done by such an under-running mechanical ear as is shown in figs. 2 and 3. The life of the trolley wire on part of the system here, where deep-grooved ears were in use, was with renewals of these ears easily three times that on the same part of the system when shallow-grooved ears were used, although these provided a perfectly smooth path for the trolley wheel. Since the mechanical ear was introduced, there has been no wear on the wires at the points of suspension, and the length of life of the wire at these points will be the length of life of the wire between the spans, which meantime it would be unnecessary and difficult to estimate.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Wrong Patent Law.

The article entitled "Wrong Patent Law," appearing in your issue of January 26th, calls for some comment. Your correspondent touches upon an important point when he suggests the desirability of making uniform the patent, design, trade mark and copyright laws of all British Colonies, but this dream is practically impossible.

In the last few months we, in Great Britain, have remodelled both our patent and trade mark laws and rules, and the desirability of the alterations we have introduced has still to be determined in practice. It cannot be expected that the Colonies will all follow our lead in the dark as to what the ultimate results may be. It is therefore inevitable, although unfortunate, that the British and Colonial laws for patents, trade marks and designs should differ sometimes, if there is to be any attempt at legal progress in this country.

Your correspondent complains very much of the patent fees in this country and compares the state of affairs in the United States favourably with ours. The American system certainly has some advantages, but it is by no means perfect, and probably our own is preferable. In most countries renewal fees are due on patents at the end of the first and every succeeding year in the life of the patent, but in this country the inventor has four years of patent rights at the

beginning without any renewal fees, and the initial costs are less than in the United States. If an inventor cannot make anything from the product of his brain after four years' legal protection he is never likely to turn his invention to profit, and it is far better that the invention should then become public property by the abandonment of the patent rights by the inventor, leaving the field open to other and perhaps more practical man who may be working on similar lines but producing something of real utility. If an invention is of any value at all, it is surely well worth the payment of the Government taxes, which, on the average, are less than £10 a year, and which do not begin to be chargeable until after four years have elapsed.

However, there is some ground for suggesting that the patent renewal fees might be reduced somewhat with advantage both to inventors and to the public.

It is hardly fair for your correspondent to condemn the new procedure of the Patent Office in making examinations as to the novelty of inventions claimed, because the system is still in its infancy, and it requires the reasonable co-operation of inventors, patent agents and the Patent Office officials to make the best that is possible out of the existing law. The law aims at preventing the promiscuous granting of patents to any and every applicant quite apart from the novelty of the invention claimed, but without interfering with the legal status of an inventor if he should prefer to take his own claims in spite of the official warning that they are not novel. The law should be strongly in favour of those real inventors and practical manufacturers who are constantly turning out inventions of practical utility and of genuine novelty.

It is not necessary to say much in reply to your correspondent's remarks as to a defaulting patent agent who took money for paying renewal fees, but neglected to effect the payments necessary for maintaining his clients' patents in force. Such things are of rare occurrence, and there are many thoroughly reliable firms of patent agents who can be depended upon to keep their clients advised of the times when tax payments fall due, and to effect the payments in due time if instructed to do so by their clients. If inventors will continue to be foolish enough to entrust large sums of money or important work to small and unknown agents in the hope of saving a few shillings by so doing, they must expect now and then to pay the penalty in the way your correspondent suggests.

Probably none of the principal patent agents in England undertake to sell their clients' inventions, because it is well known that patent selling is a business quite apart from legitimate patent agency, and no one agent can, with advantage, divide his energies between the two businesses. All the most reliable patent agents, we believe, are agents for procuring patents or registering designs and trade marks only, and for the sake of their own reputation they would obviously avoid making promises as to the sale of patents which they would be unable to fulfil. An agent often can, and does, render his clients valuable assistance by way of advice in disposing of their patent rights, but he could not afford the time which would be necessary for interviewing manufacturers and dealers and negotiating the sale in person. A patent agent has quite enough to do in securing adequate protection for his clients' inventions.

W. P. Thompson & Co.

322, High Holborn, W.C.
January 26th, 1906.

India-rubber Gloves v. Boots.

I am much interested in your article advising the use of india-rubber boots instead of gloves in high-pressure stations.

It has been the rule for a great many years in this Corporation that all employés in our sub-stations wear rubber shoes; also that under no circumstances whatever are rubber gloves to be used, except under the direct supervision of an engineer who has to be personally responsible that the gloves used are in proper condition.

From my experience, rubber shoes, besides minimising the chance of a man getting a dangerous shock to earth, very often prevent him slipping and falling against live terminals. Hand-to-hand shocks are very rare; and, after some 17 years' experience of working with high-tension current, I have seldom had a serious case of this kind brought to my notice.

I am afraid your suggestion that rubber boots should be put on "outside the ordinary footwear" will hardly work in practice, as the boot of the ordinary linesman, what with nails, &c.!! forms a fairly good metallic contact with the foot itself, especially after the owner has walked from home on a rainy morning.

All switchmen and assistants should be made to change their boots when they come on duty, and I find this system works exceedingly well. For outside work, I am afraid rubber boots are out of the question; but even here I should prefer a portable insulated platform to rubber gloves.

Now that the example set by Deptford 15 years ago to the rest of the world, of generating at a pressure of 10,000 volts, has been followed by other engineers in this country, thereby bringing into use a large number of sub-stations, &c., the question of protecting one's employés from shock is a very serious one. I find that men at times, either from carelessness or absent-mindedness, touch live terminals which they have known for years to be alive and dangerous, although there is a danger plate and pilot lamp staring them in the face at the time; to say nothing of printed rules which have been before them for years with their signature attached as having been read and noted by them.

I anticipate that, if this matter is taken up in your columns, you will have numerous letters, "probably from makers of switchgear," that, if their system is used, such accidents are impossible; but I have had some experience in switchgear myself, and, no matter what precautions are taken, or how much money is spent, some unfortunate man sooner or later gets a severe shock; and, when asked why he broke the rules or deliberately removed an earthed shield and touched a live terminal, he says he cannot account for it.

I shall be much interested to hear any further remarks on this important question.

G. W. Partridge,
Engineer, The London Electric Supply Corporation, Ltd.

London, S.W., *January 29th*, 1906.

With regard to your leaderette on india-rubber boots in your issue of January 26th, I also have often wondered that these are not more used. For some years I have worn ordinary American rubber overshoes or goloshes when inspecting accumulators. These shoes are, of course, made of very poor rubber, and would not be good enough for high voltage work, but I have found them satisfactory for anything up to 500 volts, and they are very convenient, for as long as they are kept fairly dry one can touch any part of a battery, or even dip one's finger into the acid, without getting the slightest shock.

From my own experience I should judge that slippers or boots made of good rubber, of a fair thickness, would be extremely useful and convenient for high-tension work.

G. C. Allingham.

Cardiff, *January 29th*, 1906.

[We are very pleased to learn that Mr. Partridge's exceptional experience as one of the pioneers of high-pressure work, as well as that of Mr. Allingham, bears out our ideas. Seeing that there is evidently no practical difficulty in the way, we are at a loss to understand why rubber boots or shoes are not in general use.—Eds. E.R.]

Apprenticeship by Examination.

I should like to make a few remarks on the much-debated apprenticeship question. I feel that this is a very urgent matter, and requires a lot of improvement, as at present the electrical business is being crowded with young men who have no engineering genius (to say the least), and, on the other hand, the chances are small for a really clever youth to obtain a good position in a reasonable time unless he has money behind him.

The high premium asked by most large electrical engineering firms for training a pupil, no doubt restricts the business to some extent to well-trained men, but at the same time it debars the poor man.

Many firms, some manufacturing, but mostly contracting, will take apprentices without a premium, and often pay them a wage at starting. Large numbers of boys are thus put to the business by their parents, much as they would be to a grocer or the like, and this class of youths, who do not love the business, serves to crowd it for the more deserving.

May I suggest that large engineering firms should hold a *competitive examination* for apprentices quarterly, or at other convenient time, testing them especially in regard to their technical knowledge and mechanical aptitude.

It would pay firms to do this as the cost would be slight, and it would secure a higher standard of intelligence among the men.

The youths could prepare themselves for the examination by leaving school six months or a year earlier than would otherwise have been the case, and attend a technical college for some time. This would give them a chance of seeing what the business is like before they were bound down to it.

R. Gorham.

London, N., *January 29th*, 1906.

The Future of Municipal Trading.

May I, as an humble reader of your journal, take the liberty of protesting against what seems to me to be an unwarranted and uncalled-for attack on the person and principles of the President of the Local Government Board in your issue of the 26th inst. Surely a paper devoted to electrical science should be content to wait until such a Minister as the Rt. Hon. John Burns, M.P., has the opportunity of showing what his policy in regard to municipal matters will be, before it starts prophesying all manner of disasters. Mr. John Burns's policy as a member of Sir H. Campbell-Bannerman's Cabinet will naturally be much more moderate than his opinions as a member of the L.C.C. On general grounds I cannot see why a journal like yours should take up a side in politics at all.

Your last paragraph in the article entitled the "Future of Municipal Trading" cannot fail to offend a section of your readers who do not see eye to eye with yourself in political matters. Why electrical contractors should proceed to put their accounts in order and prepare obituary notices for their businesses because of the advent of a Liberal Government to office, I cannot understand, and I do not suppose it is your intention to explain.

No doubt you may say that such readers as cannot agree with you can just go elsewhere, and no doubt such a retort as that would be reasonable enough on your part, but if you make it you cannot claim to be simply an Electrical Review.

Fred. C. Sturrock.

Monifieth, N.B., *January 26th*, 1906.

[As a trade journal, we do not wish to have anything more to do with politics than is necessary; the question of municipal trading, however, is one which, in the interests of the electrical industries, we cannot ignore. Moreover, Mr. Burns's views and intentions have been so fully and frequently enunciated, not only before but also since his elevation to Cabinet rank, that we need not wait to learn what his policy will be.

As for the municipal wiring clause, who can doubt that a House containing an immense majority largely permeated with Socialistic views, supported by a large number of members of the Progressive party of the L.C.C., and—on such matters—by the Socialist Labour party, will confer powers on municipal authorities to extend their trading enterprises?

It is a known fact that municipalities which have secured wiring powers have carried out work at less than the actual cost price. How can legitimate wiring contractors compete with price-cutting of this kind? Moreover, work carried out by municipal employés is often, owing to the laxity of discipline, less efficiently performed than that done by workmen in the employ of private contractors. Certain kinds of work should rightly be done by municipalities; but competition with their own ratepayers is not one of these.—Eds. E.R.]

Having read the article under the above heading in this week's Electrical Review, one cannot help being struck with the apathy and passive submission of electrical wiring firms, to say nothing of other tradesmen, in the recent elections. What have they done to prevent the anti-municipalisers being elected? Nothing. Not only that, but many have voted for candidates favouring municipal trading. How any member of the Electrical Contractors' Association (which has been, and is fighting for all it is worth against such trade) can vote for a man having socialistic views, is absolutely incomprehensible. Even in the Newcastle district, one of the strongest branches of the E.C.A., what have its members done to support candidates against municipal trading?

I have tried to give a little help to one of the local candidates, but am very sorry to say that I have not met any of my fellow-members of the E.C.A. in doing so. In fact, I know that some of the successful candidates, (who favour municipal trading) votes were given by some of the members of the E.C.A.

B. Robson.

Gosforth, *January 29th*, 1906.

After-Dinner Speeches.

I read with much regret in your last issue the report of Mr. Hirst's speech on the occasion of the G.E.C. dinner, in which an effort was made to cast discredit on the capabilities and work of a number of gentlemen who, until lately, held important appointments on the company's staff. I think it is only just that, as the former chief of the majority of these gentlemen, I should explain, in case it is not generally known, that they resigned, I believe, against the express wish of the company, and it appears highly improper that they, who have rendered such signal services to the company, should be publicly referred to in this manner.

A. Eckstein,

Late Managing Director of the G.E.C.

London, *January 30th*, 1906.

I should like to make a protest against the remarks passed at a recent dinner, and partly reported in your columns, on the character of members of the firm and staff who left last year. I consider those remarks to have been unwarranted and uncalled-for; unwarranted because the gentlemen in question, who had served the firm loyally for many years, were not present to defend themselves or to give their side of the question; uncalled-for because the dinner, although nominally private, is actually a public function by reason of the presence of the Press in an official capacity, not to speak of a host of customers and friends. I think, therefore, that I am justified in passing the above criticisms, and, further, in adding that the opinion is generally expressed that the remarks were undiplomatic and in the worst possible taste. It is not as if some of the gentlemen were not well known outside the firm in question, one member at least having a high reputation before he joined.

It should be borne in mind that private affairs as between directors and directors, or directors and staffs, do not interest customers who are asked as guests to an annual dinner, and not as shareholders to an annual meeting. We are quite accustomed to hear how hard the directors work, how hard the staff should work (ye gods!), of the confidence they all have in each other, of alleged unanimous decisions, and that "what we want is your orders; not excuses, but cheques"—and we take it all in good part because—well, England is a free country. But this year's washing of dirty linen is more suited to a meeting of directors and staff, and is rather calculated to leave a nasty taste in the mouth after an otherwise excellent and liberal entertainment.

I am driven to make this protest owing to the public nature of the function, and to the fact that some of my friends, both guests and victims, feel that they have cause for complaint.

Goods Traffic.

[A letter on this subject will be found in our "Notes" columns.—Eds. E.R.]

How to Screw Conduits.

As one in charge of the fitting of large quantities of screwed conduits, and in no way interested in the manufacture of any particular conduit (as those who have at present replied to Mr. Schmahl's letter appear to be), I would like to remark that I think it is high time there was some understanding amongst manufacturers as to the standardisation of conduits, threads and fittings.

There is little doubt that certain firms invented special threads in the hope that they would thereby create a monopoly and compel users to employ only their conduits and fittings for extensions and alterations.

It was put forward that these fine threads were to enable thin gauge tubing to be used, but now that such tubing is out of fashion and only heavy screwed is being used on best work, there is no more suitable thread than standard gas and gas sizes for conduit.

Mr. Schmahl is quite correct in saying that gas sizes and threads are being used on a large number of important installations.

They are also being specified by the Government engineering departments and the leading consultants, and the sooner those firms who now decline to supply gas threads and sizes wake up to this fact, the better it will be for the trade generally, and the pockets of their shareholders in particular.

J. Copon.

London, *January 27th*, 1906.

We have naturally read with considerable interest the letters which have so far appeared in your paper on the above question. We standardised gas sizes and threads when starting our business, and have so far had every reason to believe we did rightly in so doing.

We suggest that it is better to cut a gas thread on a gas size tube, rather than a thread which is "very nearly" a gas thread, such as one or two conduit manufacturers adopt.

A gas thread gives a better mechanical joint than a finer thread would do, and necessitates a heavier tube, giving better protection to the cable and, other things being equal, longer life. Tubes of gas diameter allow of a greater internal clearance, an advantage of considerable value.

As Mr. Gunner rightly says, the leading consultants are specifying gas threads, and seeing that at least four conduit manufacturers are making conduits of gas diameters, and two of them, including ourselves, are putting gas threads thereon, there would seem to be some reason for adopting gas size tubing and gas threads for conduit wiring. This does not mean necessarily the use of rough fittings, as suggested by Mr. Waterhouse.

Conduits and Fittings, Ltd.
W. H. M.

London, N.W., *January 24th*, 1906.

[A letter on this subject has come to hand from Mr. Schmahl, too late for inclusion in the present issue.—Eds. E.R.]

Leakage Indicator.

I should be pleased if Mr. Edgcumbe would kindly explain an apparatus for indicating leakage, as required by the Home Office, where the concentric earthed return system is used in mines.

The writer would like to know which is the best to use, an ohmmeter or milliamperemeter. The circuits are for power and lighting, and with an ohmmeter reading in megs, we get practically an earth on the inner conductor. I should be pleased to know if this is the best form of meter to use.

Meter.

Thermal Efficiencies.

I am pleased to find that Mr. Bennis deprecates the personalities which he first brought into this controversy by personal abuse of your "irresponsible scribbler," who he alleged to be myself to Messrs. —— and Mr. ——. It only now remains for him to express regret for the charge made in my office by his two representatives, as to which I have waited now two months for the promised explanation, as Mr. Bennis's letters (enclosed) will show. I consider this item fully 88·1 per cent. of my grievance against him, and will not ask for the remainder of 11·9 per cent., which we will allow for chimney loss and radiation.

Wm. H. Booth.

London, S.W., *January 26th*, 1906.

As I take an interest in boiler performances, I have followed the controversy on boiler efficiencies with some keenness; and, as a matter of course, I have looked into the Brighouse test as given in the red pamphlet. The performance is a very notable one, and steam users, in their enthusiasm as to the latent possibilities in boiler accessories, might readily be forgiven if they in their simplicity asked for that other 12 per cent. as a matter of no great moment.

Although this particular test is specifically stated to be a competitive one, Mr. Bennis now speaks of it as a comparative test, and this, taken together with the clearly conveyed hint that the meter was possibly out of order, leaves the impression on the mind that the whole matter must be removed from serious consideration.

The report says, "All fuel was carefully weighed, and water measured by a Siemens meter," and figures as to cost of evaporation and money saving per 1,000 gallons are plainly stated, so that we must take it for granted that the meter had been carefully calibrated by tank measurement at flows of about 1,100 and 1,400 gallons per hour, which the meter read during the quoted tests.

Page 5 of this pamphlet "trusts" the figures will be found both useful and interesting, and considering that a boiler efficiency of only 51 per cent. was obtained in the hand-fired test, one is tempted to offer a paraphrase "that the figures will be found more ornamental than useful," as being more pertinent to the case.

As a matter of curiosity, I should like to know whether test engineers as a rule are satisfied to employ such methods of measurement as seem to have satisfied Mr. Bennis; if so, will Mr. Bennis consider it unfriendly on the part of those of us who are not test engineers, if we consider all his figures as merely inferential, and not the outcome of careful calculation and calibration? If this is the case, "Calories" and the other of your "irresponsible scribblers" are justified in their strictures.

In Mr. Booth's report of the "Davies" test, both water and coal seem to have been weighed on the same scales, so that an error would not affect the result. It is well known that a lightly-worked boiler, properly attended to, will give better evaporative results than one more heavily worked, so that there can be no comparison between the Brighouse test where 34 lb. per sq. ft. of grate were burned, and the Davies boiler test of 14 lb. One can understand that Mr. Booth was justified in his protest that his findings were used to bolster up results obtained under conditions where efficiencies of 84, 86 and 88 per cent. were impossible.

I should be glad to know what are the probable chimney temperatures under ordinary heating surface ratios, with a coal consumption of 10, 20, 30 and 40 lb. per sq. ft. of grate. And also within how many degrees of boiler temperature is it possible under such conditions to reduce that of the waste gases.

I ask these questions because the extravagant claims made for boiler efficiencies would surely not be made if such points were accorded attention. As regards the "real efficiency" of a boiler in absorbing heat, I should like to point out that this is really a trifle better than Mr. Booth calculates from the heat in the steam, because any heat lost from parts of the boiler not in the combustion chamber space must, of course, first have been absorbed.

W. G.

I have perused with some interest and not a little amusement the contributions of your correspondents. To my mind the criticism of Mr. Bennis is scarcely fair; the difference of opinion is mainly concerning what is after all only *a test efficiency*. This should not be lost sight of; an average every-day working efficiency is another story altogether.

On this occasion, as on previous occasions, Mr. Bennis appears to have a particular grievance against the anonymous

contributor; in this I sympathise with him. Those who make it their business to pull to pieces the figures of others should come out into the open and not conceal their identity. In this case such concealment has apparently had the effect of subjecting my good friend Mr. Booth to some little annoyance.

Mr. Charles Erith being interested in fan draught is accordingly led to ridicule the steam jet, but when he proceeds to observe that a low boiler efficiency must be expected if slack is to be burned smokelessly, he is presumably referring to his own stoker and fan draught?

The use of the despised steam jet is not peculiar to the Bennis stoker. Steam jet blowers are, of course, used with Meldrum stokers, and no difficulty is experienced in obtaining an output from the average boiler of 50 per cent. above its rated capacity when burning a cheap slack fuel, while keeping a clean chimney.

Mr. Erith might have made clear to your readers why a *moderate* rate of combustion is absolutely necessary with an underfeed stoker if slack is to be burned smokelessly, and had Mr. Erith elected to adopt this course instead of generalising, he would have been compelled to admit that the *underfeeding* of fuel, as compared with overfeeding, is essentially a slow process involving, as Mr. Erith states, "a lower boiler capacity than if best smokeless fuel were used on the same furnace area."

In short, underfeeding means under-working in the case of an internally fired boiler. In Canada and the United States this is not only recognised by the steam user, but freely admitted by the makers.

W. Francis Goodrich.

Westminster, *January 24th*, 1906.

Electric Lifts.

The article on electric lifts by Mr. Good in your issue of January 5th interested me considerably, and followed as it has been by Messrs. Waygood's letter of the 19th current, I am prompted to add my quota to the discussion.

It has long been a marvel to me that makers of, and specialists in, electric lifts were satisfied with such deplorably low efficiencies when, with the outlay of a little of what the Americans call "gray matter," so much better results are attainable. Presuming that Mr. Good is associated with Messrs. Richmond, the efficiencies which he is not ashamed to publish in an article comparing electric with hydraulic lift efficiencies are as follows :—

No. 1 lift, 10 cwt.,	at 109 ft.	per min.	Efficiency 31	per cent.
No. 2 lift, 3 ,,	at 109	,,	,, 16·5	,,
No. 3 lift, 7½ ,,	at 69	,,	,, 16·5	,,
No. 4 lift, 10 ,,	at 105	,,	,, 41·4	,,

The above efficiencies are based on running currents.

Messrs. Waygood suggest that the proper basis for stating commercial efficiency is the number of trips per Board of Trade unit. Their three lifts have the following efficiencies :—

No. 1 lift, 10 cwt.,	at 200 ft.	per min.	Efficiency 34·2	per cent.
No. 2 lift, 10 ,,	at 150	,,	,, 33·5	,,
No. 3 lift. 10 ,,	at 200	,,	,, 31·8	,,

These efficiencies are obtained by taking Messrs. Waygood's figures, which include up and down journeys, and correcting them (to eliminate the down journey) in the ratio of 11·1 to 8·2—Mr. Good's figures for the double trip and single up journey of his 10 cwt. lift No. 1.

I am not inviting a comparison between one maker and another because the things are not on the same basis, the Waygood lifts quoted being much more powerful than the others, but the point is that two presumably first-class lift builders are satisfied with efficiencies of the order of 33 per cent. (in fact, Mr. Good almost apologises when with the accidental combination, which he has not recognised, of an 8 H.P. low voltage motor and steel guides he gets 41·4 per cent. efficiency). They are not alone or peculiar in this respect either, for my office here is served by an A. & P. Steven lift which is just as good or bad, and close at hand is an Otis lift with 35 per cent. efficiency.

The reason for all this is not far to seek.

Worm gear has been regarded as safe; originally made with a single-thread worm of small pitch and large diameter, it had a sufficiently low efficiency to be absolutely self-sustaining, a feature necessary with belted hoists and prior to the introduction of electro-magnetic release brakes. Adopted by the earlier electric lift builders, it has been slavishly copied and regarded as a fetish by all, I believe, except the Sprague people. Association with the bad or poor workmanship of a cast worm wheel led to the use of inefficient thrust bearings, and inefficient journal bearings —merely a hole drilled in a chunk of cast-iron, and both retained at the present day, although cut worm gear is now the rule rather than the exception.

No one, in the 20th century, can be excused for the omission of ball-thrust bearings or of self-oiling ring or roller bearings for the shafts. But is there any valid excuse for single-thread inefficient worm gear? In the writer's opinion there is not. Those who prefer worm gear can, and should, make it efficient mechanically, and rely for safety not on inefficiency, which necessarily means wear and tear, but on independent and adequate safety devices in combination with high efficiency gear. The thing is perfectly practicable. Worm gear, however, is not, in the writer's opinion, necessarily the best solution. Double reduction spur gear has been used in several cases with perfect success, and in combination with decent mechanical arrangements (ring-oiling or roller-bearings) has resulted in efficiencies of 70 per cent., and, of course, in a negative consumption, that is, the return of current to the line when going up empty and coming down full.

One case was of peculiar interest. A lift of the regular inefficient type was installed by a well-known maker at a railway hotel in the country with its own isolated generating plant of modest dimensions. The starting and running currents were so enormous that it became impossible to operate the lift in the evening when the lights were on. The gearing was pulled out, double-reduction spur gear substituted with self-oiling bearings, and the starting current was about halved, the running current cut down in the same proportion, and the efficiency (including the current for a quick-acting electro-magnetic brake in place of a mere mechanical brake) raised from 20·8 per cent. to 41 per cent. The lift was only a small one, running at a slow speed, the winding drum shaft could not, owing to structural reasons, be fitted with self-oiling bearings, and the two traversing guide sheaves still screwed their weary way along a plain, plain shaft, hence the highest efficiency was not to be expected.

In another case where rational gear was fitted in a new building, above the lift well, the efficiency was over 70 per cent., the load being 10 cwt. at 100 ft. per min., and the running on a 220-volt circuit.

The effect of high efficiency on the working costs is even greater than might be supposed, because not only is the normal load current reduced, but there is no current absorbed when coming down full or when going up empty—in fact, under these conditions, current is generated and returned to the line, and, on certain forms of meter, this might be credited, although the quantity will not be great. Altogether there is no difficulty in cutting down the consumption by 50 per cent., so that the saving over hydraulic lift costs in the case taken by Messrs. Waygood would be £42 16s., instead of £31 2s. per annum.

How long is inefficiency to persist under the cloak of "37½ trips per unit" when it can be definitely stated that: "A total loss of all but 34·2 per cent. of the metered units is guaranteed under favourable conditions."

W. L. Spence.

Glasgow, *January 30th*, 1906.

P.S.—In calculating the duty and efficiency the net unbalanced load has, of course, been taken throughout.

With reference to Messrs. Waygood's criticism of the tests on electric lifts, I should like to make the following remarks :—

With a meter reading one division of the last dial per B.T.U., it takes several hours to obtain the current consumption of a lift. This result could be obtained in as many minutes using an ammeter and voltmeter or a wattmeter. I compared results obtained in this way with those obtained when using a meter which gave an accurate reading of the

consumption for one journey, and I found that the ammeter and voltmeter method was quite satisfactory.

The results of tests given in the article are not estimates. I certainly did show how the ordinary results, such as Messrs. Waygood give, could be altered so that an objection raised by the London Hydraulic Power Co. could be removed. The objection, as my results show, was a fair one.

The figures which Messrs. Waygood give, and from which they calculate a consumption of 4·5 B.T.U. for 150 journeys, are useful, but cannot be compared, as the lifts are very different. I must point out, however, that, using their figures as a basis, I find the consumption for 150 journeys works out at 4·9 B.T.U. This, of course, alters to some extent the remainder of their calculations.

It should be noticed that in all my calculations I was careful not to overstate the case for the electric lift, and, consequently, I took 2½d. per B.T.U., although I also think it can be usually obtained for 2d. per B.T.U. In fact, Messrs. Waygood's results are in fair agreement with my own; but I gave full particulars in order that a fair comparison between the hydraulic and the electric could be obtained for any particular case.

I should like to call Messrs. Waygood's attention to the concluding paragraphs, where I mention both first cost and maintenance. Of course, I agree with them as to the importance of these, but it is not correct to say that I ignore them.

I should like to take this opportunity of thanking Messrs. J. Richmond and the Electrical Testing Institution for their assistance in carrying out the tests.

Percy Good.

Putney, *January 29th*, 1906.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Reference" writes:—"We shall be glad to know whether we can obtain information as to the law relating to the running of overhead wires across the public roads. We wish to supply a works across the road from ours. The power company have, however, rights of supply in the park, and we shall be glad to know what rules have to be complied with in running the wires, and whether there is any objection to these wires crossing a public road, or whether the supply company could prevent us from supplying."

*** There can be no doubt whatever that an electric supply company, as such, has no possible right to interfere with the powers which "Reference" desires to exercise. A question may, however, arise as to whether the local authority who have control of the highway in question, will permit wires or cables to be suspended across it. Much will depend upon the degree of control which this body are entitled to exercise over this particular road. If they own the freehold in the soil of the highway, they are entitled to prevent wires being suspended over it at any height. Where, however, they merely exercise the usual power of a highway authority, namely, the necessary power to keep the surface of the road in good repair and free for passing traffic, they have no power to prevent the suspension of cables over the road at such a height as to be clear of the traffic. Assuming, then, that "Reference" has no difficulty of this kind to face, he must obtain and comply with a copy of the Board of Trade Regulations which deal with overhead wires. He can obtain these regulations (or obtain information as to where to find them) by making application at the offices of the Board of Trade, Whitehall, S.W. He should take care to specify that he wants the regulations relating to the erection of overhead wires otherwise than under the powers of a provisional order or special Act.

LEGAL.

£225 for Damaged Eyesight.

Wm. Vinecombe, a fitter's mate, brought an action against the Underground Electric Railways of London, Ltd., at the Brompton County Court, on Wednesday last week, to recover damages under the Employers' Liability Act in respect to an injury to an eye, which will probably result in complete loss of sight.—Mr. Scanlan (instructed by Mr. Dabbs) was for the plaintiff, and Mr. N. Scarlett for the defendants.—Plaintiff, who lives at North End Road, Fulham, said he was instructed by his foreman on a certain day in September to grind some iron bars on the emery wheels at the Acton Works. As he was doing so a spark flew into his eye. It gave him considerable pain, and on the next day he had to give up work.—Mr. W. R. Pether, consulting engineer, said emery wheels, in his opinion, should be more completely guarded than were those of the defendants. If there were a circular guard with an opening at the bottom for the particles to fall out, any danger would be obviated.—Mr. Scanlan submitted that the machines were insufficiently guarded; and, further, that plaintiff should have been provided with goggles.—Mr. Charles Frederick Fuller, consulting engineer, called for the defence, referred to the accident as an extraordinary one. During the whole of his 30 years' experience he had not heard of another such. In the natural course of things, a wheel travelling at a very high rate of speed, such as an emery wheel, would cause a vortex in which all particles would be carried along. It was true that goggles were provided in cutlery works, but with such work the operators had to bend very closely over the wheels.—The jury awarded plaintiff £225 damages. Costs were allowed.

Mayfield & Co. *v.* Pearce.

In the City of London Court, on Tuesday last week, before his Honour Judge Lumley Smith, K.C., an action was brought by Messrs. J. T. Mayfield & Co., electricians, 63, Cannon Street, E.C., to recover the sum of £3 15s. against Mr. J. Pearce, 93, Shirland Road, West Kilburn, for supplying electric fittings to his order.—Mr. Cole, plaintiffs' representative, said he took the order from the defendant, and the price was fixed at £3 15s.—The defendant complained to the Court that the plaintiffs' charges were excessive, and said that Mr. Cole was very pushing to get the order, and he worried him considerably.—Judge Lumley Smith: They always do.—The defendant added that Cole made out an estimate and said it would be £1 19s.—Witness then said that was cheap, and hoped it would not be cheap and nasty. Cole said it would not.—Mr. Cole denied that, and said he fixed four lights, a pedestal, and a special green shade.—Judge Lumley Smith: I always thought that a guinea a light was the proper charge for electrical fittings.—The defendant: I have since made them a present to the landlord.—Judge Lumley Smith told the defendant that if he liked to do that he could, but in the meantime he could not say that the plaintiffs' charges were too much.—Judgment for them with costs.

Municipal Tramway Powers: Corporations as Public Carriers.

To all municipalities owning or carrying on tramways an action brought against the Manchester Corporation, and heard before Mr. Justice Farwell in the Chancery Division of the High Court, is of the utmost importance. The fight was as to how far a Corporation might go in the working and development of its tramway system. The question was raised by Messrs. Sutton & Co., the well-known carriers, who asked the Court to declare that the Corporation have no power to convey, collect or deliver for reward any goods or parcels by means of road-vans, hand-carts or messengers, or to accept any parcel or goods for such conveyance, collection or delivery, or to act as general carriers or as parcels delivery agents, forwarding or railways agents, or to undertake the collection of the value of the goods on delivery. Messrs. Sutton contended that it was wrong for a Corporation to spend money out of the city rates for the carrying on of a common carrier's business, and asked the Court to grant an injunction restraining the City authority from doing what plaintiffs sought to show was not allowable under the Tramway Acts.

The case was argued before his Lordship on Monday and Tuesday, and judgment was reserved.

Mr. Upjohn, K.C., Mr. Lush, K.C., and Mr. Rowlett appeared for Messrs. Sutton, and Mr. Balfour Browne, K.C., Mr. Macmorran, K.C., and Mr. Hugh Fletcher Moulton represented the Corporation.

Mr. Upjohn, K.C., in opening, surveyed the various Acts of Parliament which bestowed the powers of working the tramways, his object being to show how far a Corporation might go as a trading concern. It was, he said, under the guise of one of those powers that the Corporation had established a complete business of common carriers and collecting agents. It had founded, independently of its tramways, a chief office and a chief depôt, and a large number of depôts at which goods were received. The Corporation had a very large number of agents all over the district who received parcels, the agencies and depôts extending over an area of four miles beyond the tramway termini. There were quite 50 vans and 100 horses employed in this business. The Corporation had hired a chief depôt, which was a basement for receiving and sorting goods, and a single line of tramway had been made into it. The sum of £3,185 had been spent on that work; £1,600 on vans, harness, &c., £800 stabling, and £3,200 on horses. Reviewing the steps taken to set the carrying business into operation, Mr. Upjohn said the Corporation had got into trouble with the Trades Unionists of the district because they had contemplated going out of Manchester for the saddlery required.

Mr. Justice Farwell said he thought they were Free Traders in Manchester.

Mr. Upjohn: I am glad to say they are, because the Corporation has given notice to introduce a Bill in the first session of the new Parliament to give them power to do what we complain of them doing, and at a statutory meeting of the ratepayers that Bill was unanimously rejected. I think they showed there that they were Free Traders and did not intend to have Protection at their own expense.

The learned counsel went on to show the financial results of the undertaking, when his Lordship observed that it did not seem to have been particularly successful from a financial point of view. He had nothing to do, however, with the question of policy.

Mr. Balfour Browne, on behalf of the Corporation, claimed that they had a right to act as they had done under the powers conferred on them by the Tramways Act. All the Corporation had done was incidental to, or consequential on, the powers it had to carry goods or parcels by tramway. The Corporation might have power to do things that the statute had not given it power to do because it was a chartered corporation as well as a statutory body. The carrier business was properly incidental to the tramway business.

Mr. Macmorran followed on the same side, and contended that there must be power of delivery; for that there was a considerable amount of authority. The learned counsel cited a case to show that the delivery and collection of goods, with all that that implied, in the way of accommodation, horses, vans and men, was a reasonable and usual incident to the Manchester Corporation tramway business, which included the carriage and conveyance of goods and parcels.

His Lordship intimated that he intended to put his judgment into writing, having regard to the importance of the case. He agreed with counsel that there must be accommodation at each end for goods, and, as at present advised, he thought the Corporation might distribute; but where he found difficulty was in the contention that they could go from the extreme north of Manchester to places outside the bounds.

Mr. Macmorran explained that the tramway area extended a long way beyond the city of Manchester.

His Lordship said, as he understood it, the Corporation claimed that when their carts were at Rochdale they had the right to collect parcels there and deliver them at Heywood.

Mr. Macmorran replied that the Corporation claimed that as their tramways went beyond the city as far as Middleton depôt they had a right to distribute from that depôt, and that the same carts which were employed for the delivery of goods might be employed for the collection of goods.

Mr. Upjohn replied on the whole case, and contested the right of the Corporation to go beyond the tramway termini in delivering or collecting parcels. The power given under the statute that "tramways may be used for the purpose of conveying and delivering goods or parcels," was a power to use the tramways for conveying goods or parcels and collecting or delivering them at a tramway depôt, and not a power to collect and deliver parcels away from the tramways.

Richmond and Portrane Asylums Board *v.* Edmundson.

In the King's Bench Division on 16th ult. (according to the *Irish Times*), before Mr. Justice Wright, in a case in which the Joint Committee of Management of the Richmond and Portrane District Lunatic Asylums were plaintiffs and Mr. John Edmundson was defendant, Mr. Jefferson applied on behalf of the plaintiffs for an order for discovery of documents. The action was brought to recover the sum of £500 damages for alleged negligence, breach of duty, and want of care on the part of the defendant, an electrical engineer, in carrying out electric installations, including the putting up of telephones and tell-tale clocks in Portrane Asylum under contract with the plaintiffs. A number of reports, counsel stated, must have been made on the subject; and it was for the inspection of these that the application was made.—Mr. Justice Wright granted the application.

BUSINESS NOTES.

Consular Notes.—Sweden.—According to the United States Consul at Gothenburg, all the streams of Sweden with a fall of water sufficient to generate electricity are soon to be harnessed for industrial purposes, and companies are being organised with this object in view. The company, "Sydsvenska Elektriska Aktiebolaget," was on the point of being incorporated and registered at the time of writing. The business of the company will be to buy real estate and waterfalls, and to erect plant for the production, distribution and use of electrical power, and allied branches of business. The seat of the board of directors is the city of Halmstad. The minimum capital is about £188,000, and the maximum about £536,000. A plan to utilise the water power of the River Lagan has been worked out. The plan is that the company shall, to begin with, purchase the unused waterfalls in the River Lagan, and build seven power stations there. A smaller plan of operations includes ten larger places to which electric power is to be transmitted. According to this smaller plan, which is to be carried out first, the transmissions, with branch lines, will be 186 miles long and capable of distributing 13,000 h.p. When complete plans have been carried out the last-named figures will be doubled. For carrying out the small plan the cost is calculated to be about £552,000, but the larger system will cost about £214,000 more. The estimates for the scheme first mentioned are as follows:—For waterworks building, £182,000; for machinery, £80,000; for transmission cables and wires, £97,000; and for regulating the access and supply of water, £54,000. It is intended to make the price of the electric power so low that the same can compete with the cheapest motive power obtained in any other manner, and as soon as certain contracts with various communities have been signed the work will begin. It is considered that the negotiations and the work on the different plants will take two years before any power can be distributed.

Bavaria.—The British Consul at Munich in a recent report states that the Munich municipal tramways suffer from over-capitalisation, the Town Council having bought the concern from a private company with the stipulation to pay 11 per cent. dividend until June 30th, 1906, when the entire electric tramway system will pass into the hands of the Municipal Council for the final sum of £35,660. In existing circumstances, the undertaking is far from flourishing, and in spite of having changed the rate of fares several times during the past few years, there was a deficit of £6,500 in 1904-5.

Graphite did very well in 1904; prices rose in consequence of an increased demand for crucibles, a result of more shipbuilding and new armaments in Germany. The export to Austria-Hungary and to the German States themselves, such as Saxony, Rhenish Russia and Hanover, has trebled. In 1903, Bavaria produced 3,719 tons of graphite to the value of £7,439; in 1904, 3,784 tons to the value of £8,429.

The electric machinery industry was one of those which profited most by the improved conditions of trade and commerce in 1904. The largest electrical machinery company in Bavaria paid no dividend in 1903-4, whilst in 1904-5 it yielded one of 4 per cent.

Since July, 1905, the Munich Post Office has used the municipal electric tramways for the transport of letters and parcels between the central and branch offices. The tramway company furnished two cars at a cost of £600 each, the driver and conductor of each car being officials of the postal authorities. The platforms of the cars are closed, the interior, lighted electrically, being divided into two compartments, the larger one for ordinary, and the smaller one for registered postal matter. The windows are protected by strong iron gratings, the doors being also of iron. The exterior is like that of an ordinary Royal Bavarian mail cart. The postal authorities pay an average of 20 pfennige (2½d.) per kilometre, a quota of 4 per cent. for expenses incurred, and 6 per cent. amortisation.

Instead of constructing necessary but expensive railway branch lines which yield a low rate of interest on the capital, the Bavarian Government inaugurated in the highlands during the summer of 1905 three lines of motor-omnibuses, viz., Tölz-Lenggries, Tölz-Bichl and Southofen-Hindelang.

Chimney Building.—A chimney shaft 120 ft. high from foundation has been completed at the Dundee Electric Tramways station at Monifieth within 25 working days. The order has been placed with the Ferbeck Chimney Construction Co., London, E.C., by Messrs. J. G. White & Co., Ltd.

Advance in German Prices.—The greater cost of raw materials in recent months is bringing about a general increase in the selling prices of manufactures. It is only a short time since the principal companies introduced an advance of 10 per cent. for dynamos, motors and transformers, and this was soon extended so as to apply to all apparatus used in heavy electrical engineering work, including general installation materials. It is now stated that a further increase of 5 per cent. has been made in the prices of machinery and apparatus. In addition to this, the Berlin-Hagen Accumulator Co., which is the leading firm engaged in this branch in Germany, has notified a rise of 10 per cent. It is expected that the Boese Accumulator Co. will soon follow the example, if it has not already done so.

German Banks and Electrical Companies.—It has been pointed out on more than one occasion that German banks take a considerable amount of interest in the principal electrical engineering companies in that country. Some of the financial institutions undertake the responsibility of representing shareholders at the annual meetings. The following is a list of banks which attended the recent assembly of the Allgemeine Electricity Co., in Berlin:—

Name of institution.	Capital represented.
Deutsche Bank	... £415,000
Disconto Gesellschaft	... 150,000
Darmstadt Bank	... 70,000
Handels Gesellschaft	... 145,000
S. Bleichroder	... 105,000
Dresden Bank	... 100,000
Delbruck, Leo & Co.	... 80,000
National Bank	... 68,000
Born & Busse	... 45,000
Schaaffhausen Bank Verein	... 25,000

Although the banks are financially interested in the company, it does not necessarily follow that the amount of capital placed opposite the name of each institution represents the actual investment held by each. It rather shows individual interest largely in combination with the representation of shareholders who are, in all probability, customers of the banks At the same meeting the attendance list also indicated that the Zurich Company for Electrical Enterprises represented a share capital of £123,000; Ludwig Loewe & Co., £178,000; Brown, Boveri & Co., £39,000; and Sulzbach Bros., shares amounting to £24,000.

Electrical Work in Japan.—We are indebted to the *Anglo-Japanese Gazette* for the following items relating to electric light and traction progress in Japan:—

Tokio Electric Light Co., Ltd.—The accounts for the half-year ended November 30th last show that a net income of 309,168 yen

has been earned. A dividend at the rate of 12 per cent. per annum was declared, and 15,493 yen placed to the reserve fund, leaving a small balance to be carried forward to the next account.

Tokio Electric Railway Co.—The directors' report shows that the net profit for the six months ended September 30th last, including the sum of 14,901 yen brought forward from the last account, amounted to 57,062 yen. This amount it was decided to apportion as follows:—To reserve fund, 4,216 yen; gratuities to officials, 2,800 yen; dividend of 0·62½ yen (2½ per cent.) on the old shares, and 0·37½ yen (1⅛ per cent.) on the new shares, absorbing 49,000 yen, carrying forward to the next account 1,046 yen. Application had been made for concessions to construct the following lines:—From Amashiro-cho, Azabu to Zaimoku-cho in Azabu *viâ* Sakashita-cho, Miyashita-cho and Higakubo-cho; and, secondly, a line from Hiroo-machi, Azabu, to Kurama-cho in Shiba *viâ* Matsuzaka-cho and Isarago-machi in Mita; and, by reason of other connections, it was decided to apply for permission to cancel the following concessions:—From Shibaguchi (Itcho-me) to Shimbashi station, and from Futabacho in Shiba to the north corner of Uchisaiwai-cho Kojimachi.

Yokohama.—The Yokohama Electric Tramway Co. have placed a contract with the Japanese engineering and contracting firm of Messrs. Takata & Co. for the following additional rolling stock:—6 No. 21-E Brill trucks, having a gauge of 54 in., wheel base 6 ft., diameter of wheel 30 in., axles 3¾ in. These trucks will carry 18-ft. closed car bodies, the length over platform being 25 ft. and the width 6 ft. The car bodies will be built in Japan, and the trucks will be arranged to take Sterling brakes, which Messrs. Takata have ordered in the United States. The order for the motor equipments has been placed with the Westinghouse Electric and Manufacturing Co., and consists of six double motor equipments, each of two Westinghouse 12-H.P. and 25-H.P. railway motors, the motors to have nose suspension, and to be complete with suitable gears, gear case, pinions, &c. Each equipment will be supplied with two Westinghouse No. 211 brake controllers, and will also be supplied with double trolleys with 14-ft. poles, the distance between trolley wires being 18 in. A large order for spare gear and motor parts has been placed with the same company. Six pairs of Van Dorn automatic draw-bars, No. 5, with ball joint suitable for pulling a trailer weighing 20 tons, have also been ordered for the trucks. Our contemporary adds:—"The greater portion of the equipment has been ordered from America, and it seems evident, judging by the number of contracts which Messrs. Takata and other Japanese contractors place in that country and on the Continent, that British electrical manufacturers are not securing a fair share of the orders being given out in Japan."

United States Electrical Progress.—Remarkable progress has been made by the electrical industry in the United States during the past year, says the *Financial Times*. According to the last issue of the *Boston News Bureau*, the value of electrical apparatus manufactured was $217,000,000, or $41,500,000 more than in 1904. $42,000,000 of the above total is represented by motor-cars, $40,000,000 by insulated wire and cables and $37,500,000 by telephone apparatus.

Estimated earnings of the different classes of electrical corporations during last year were as follows:—

	1905.	1904.
Telegraph and cable companies	$45,000,000	$40,000,000
Telephone companies	140,000,000	111,000,000
Electric light companies	135,000,000	120,000,000
Street and other railway companies	325,000,000	290,000,000
Isolated plant supply companies	75,000,000	60,000,000

The increase for 1905 is no less than $100,000,000.

Trade Announcements.—The premises (Fulham Palace Road) and business of the SOUTH-WESTERN ELECTRICAL Co. have been acquired by Mr. Claude S. Hunter, and will be personally carried on by him under the name of the ELECTRICAL CONTRACTING Co. The old staff is being retained.

The WEST BROMWICH ELECTRIC LIGHT AND POWER Co., which was established in 1898 by Messrs. F. R. Richardson and J. D. Carlmark, has altered its name in consequence of confusion that has arisen since the opening of the Corporation electricity department, leading to the misdirection of letters, &c. The business will in future be carried on by the two partners mentioned, under the title of RICHARDSON & CARLMARK, at 402, High Street, West Bromwich.

Dissolutions and Liquidations.—The WEBSTER ELECTRICAL ENGINEERING Co., LTD.—A petition to wind up this company has been presented by the Midland Electric Wire Co., of Leicester, and is to be heard at Bradford on February 13th.

DEWSBURY, BATLEY AND BIRSTALL TRAMWAYS Co., LTD.—The company is winding up voluntarily, with Mr. Stewart Humphrey as liquidator.

MEXICAN ELECTRIC WORKS, LTD.—This company is winding up voluntarily, with Mr. A. Ellert, of London, as liquidator.

DOMESTIC SUPPLY Co.—Messrs. T. J. Gough, electrical engineer, and Joseph Ogden, works manager (Domestic Supply Co., 94, Market Street, Manchester), have dissolved partnership. Mr. Ogden attends to debts and continues the business.

The VICTORIA ELECTRICAL Co.—Messrs. A. Perricord, R. Vivian and R. W. Whaley, electrical engineers, 47, Victoria Street, Westminster, have dissolved partnership, Mr. R. Vivian having retired from the firm.

OTTO ELECTRICAL MANUFACTURING Co. (1905), LTD.—Creditors must send particulars of their debts to the liquidator, Mr. E. H. Fletcher, 14, George Street, Mansion House, E.C., by March 17th.

APOSTOLOFF AUTOMATIC TELEPHONE PARENT SYNDICATE.—A meeting is to be held at 14, George Street, Mansion House, on March 6th, to hear an account of the winding up from the liquidator, Mr. Ernest Cooper.

ROBB & MITCHELL (Electrical Engineers, Victoria Mills, Ossett).—Messrs. W. Robb and C. Mitchell have dissolved partnership.

The UNITED ELECTRIC Co., Electrical Engineers, 38, South Castle Street, Benn's Gardens, Liverpool.—Messrs. W. Turnbull Gray and Thomas Bogle have dissolved partnership. Mr. Bogle will attend to debts.

A New Journal.—We have received the first number of *Tire News*, a monthly paper published in New York. It will devote itself to the discussion of matters relating to rubber tires for automobile and other purposes. The new paper is issued from the offices of our old friend the *India-Rubber World* (150, Nassau Street, New York).

Old Copper.—The BRITISH INSULATED AND HELSBY CABLES, LTD., has purchased from the Bradford Electricity Committee 16 tons of scrap copper at £83 per ton, and 16 tons of scrap lead at £16 per ton.

For Sale.—The stock-in-trade of PULLEN & SHORE, LTD., Bolton (in liquidation), is to be sold by tender on February 9th. Some particulars appear among our advertisements to-day.

Electro-Therapeutic Exhibition.—A successful exhibition of the British Electro-Therapeutic Society was held at the rooms of the London Medical Society, Chandos Street, W., recently. Among the exhibitors were Messrs. H. W. Cox, Ltd., who showed a complete X-ray outfit and radiograph; Messrs. W. Watson and Sons, who exhibited induction coils, intensity coils, &c.; Mr. E. M. Holquist, who had on display the Sunbeam electric light bath; and Messrs. Krupka & Jacoby, whose exhibit consisted of a complete portable pedestal outfit including motors, operating surgical and massage instruments, examination lamps, cauteries, &c., and instruments used in connection with faradisation, galvanisation, electrolysis, &c. The "Tantalum" lamp was also to the fore.

Annual Dinner.—The annual staff dinner of Messrs. W. T. Glover & Co., Ltd., was held at the Trafford Park Works on the 25th ult., and a smoking concert followed. Mr. E. A. Claremont, the managing director, was in the chair, and over 200 members of the staff attended.

Parliamentary.—*Scottish Bills.*—On Monday, Mr. Campion, one of the Examiners, had before him the Scottish Orders, which are being promoted this session, and which, after passing the preliminary Standing Order stage, will be dealt with locally, unless Parliament decides otherwise. The Examiner found that all the necessary steps had been complied with in the case of the following Bills:—

Edinburgh Corporation.—In this Bill powers are taken for the construction of new tramways, the estimated cost of which is put down at £116,057.

Edinburgh Suburban Electric Tramways.—Suspended Bill from last session.

The consideration of the following Bills was postponed until February 20th:—

Dumbartonshire Tramways.—To confer powers on the Electric Supply Corporation, Ltd., with regard to the maintenance and construction of tramways in the county. About 11 miles of tramways are proposed, and the engineer's estimate is £83,065.

Ardrossan, Saltcoats and District Tramways.—Proposed to incorporate a company with a capital of £150,000, to construct about 11½ miles of tramways. Engineer's estimate, £64,503.

Dunfermline and District Tramways.—To incorporate a company with a capital of £250,000 to make and maintain 18 miles of tramways. Engineer's estimate, £88,661.

Falkirk and District Tramways.—To empower the company to construct an additional 6 miles of tramways at an estimated cost of £35,291.

Notice of opposition has been lodged in the case of the last three Bills.

Standing Orders.—On Monday, Mr. Jeune, one of the Examiners, found that Standing Orders had been complied with in the case of the Wallasey Tramways and Improvements Bill, and the North and South Shields Electric Railway. The consideration of the North-East London Railway Bill was postponed, it being stated that there was a meeting of parties that day with a view to avoiding any non-compliance.

Callender's Hospital and Distress Fund.—We have received a copy of the third annual report and balance-sheet of this excellent fund. The general meeting was held at Erith on January 20th, with Mr. T. O. Callender in the chair. Altogether the penny weekly subscriptions of the members realised the handsome sum of £247 odd, and to this Callender's Cable Co. added £50, and a number of friends a further £26. Letters for surgical appliances were granted to 87 members, for convalescent homes to seven members, and £57 10s. was distributed in cases of distress. A large sum was distributed in the form of annual grants to a number of hospitals and other institutions. Mr. W. E. Wimshurst is hon. secretary and treasurer of the fund.

France.—Two French aluminium-producing companies, viz., the Société de Neuhausen and the Cie. des Produits Chimiques d'Alais et de la Camargue, have combined to form the Société Electro-Métallurgique Française de Froges with a capital of 10,000,000 francs. The capital was subscribed several times over.

The Société pour l'Electro-métallurgie en Espagne has been formed with offices at Rue de l'Arcade, 36, Paris, and with a capital of 40,000 fr., with a view to the exploitation in Spain of the patents of C. Tossizza for two processes for the electrolytic extraction of copper and zinc. The directors are Messrs. J. Tossizza, de Mayol, de Lupé, de Joly, Paul du Buit, Alberto Thiebaut and Pedro Chalbaud y Errazquin.

Catalogues and Lists.—The C. W. Hunt Co., New York.—Another of their series of fully illustrated catalogues. It gives a detailed account of the Hunt "Industrial" railway.

From the Trafford Park Estates, Ltd., of Manchester, we have received an interesting pamphlet relating to Trafford Park as a desirable manufacturing centre. Photographic views typical of the various works and industries in operation there are given. Manufacturers in search of a suitable locality for new factories should read the pamphlet.

The General Electric Co., Ltd., London, E.C.—A new pamphlet (H 1,102) showing many new and attractive designs of electric radiators for service in offices, bed and drawing rooms, halls, and on board ship. We understand that the prices have now been considerably reduced in the hope of making electric heating more popular among the general public.

The Sun Electrical Co., Ltd., Charing Cross Road, W.C.—Catalogue (36 pp.) section M., giving specification matter, illustrations, tabulated data of outputs, speeds and prices of continuous current dynamos and motors, also single-phase induction motors, motor-generators, electro-plating dynamos, regulators, dynamo brushes, portable electric drilling machines, electrically-driven boot and knife machines, and other electrical machinery.

The Concordia Electric Wire Co., Ltd, 34, Queen Street, E.C.—Illustrated list of their new flexible arm electric desk lamp, for draughtsmen, book-keepers, engineers, &c., employed on close works.

The City of London Wood-Wool Co., of Plover Works, Hackney Wick, N.E., have sent us samples of their wood-fibre suitable for packing goods. It is claimed to be specially light, being cut from white pulp wood.

Messrs. Geipel & Lange, London, S.E.—Interesting pamphlet illustrating some of the everyday applications of the "Economical Turn-Down" lamp; also a list relating to Okonite and Manson insulating and protecting tapes, with names of a number of electricity works where they are in use.

The British Westinghouse Electric and Manufacturing Co., Ltd.—Several illustrated publications, dealing respectively with the Westinghouse-Bremer open arc lamp, type "S.B." direct-current motors, and direct-current engine-type generators. Dimensional drawings, tabulated data and half-tone views of plant running in several English electricity supply stations appear.

Messrs. Wm. Wadsworth & Sons, School Hill, Bolton.—Illustrated catalogue of hoisting machinery. The firm makes any type of hoist or lift (excepting hydraulic). Among the various contents of this 76-pp. catalogue we find some general notes on electric lifts, and the cost of working same. The electrical specialities described are self-landing and delivering hoists, goods lifts, passenger lifts, and friction hoists, while there are in the hand section overhead tram-rail and trolley-hoists, warehouse lifts, jib-cranes and many handy hoist accessories. An accompanying booklet contains a collection of numerous testimonials that have been received by the firm from users of their hoisting and conveying machinery.

Mr. E. B. Gray, Hythe, Colchester.—Price lists of direct-current motors from ½ to 13 h.p.; also motor-starters.

Messrs. Chas. Macintosh & Co., Ltd., Cambridge Street, Manchester.—Small catalogue (18-pp.) giving details in tabulated form of their vulcanised india-rubber wires and cables for electrical work; also flexible cords, telephone wires, jointing materials, &c. Some loose lists give particulars of the firm's W. and R. dry battery.

Motor-cars in Australia.—From the British Empire Motor Trades Alliance, Ltd., we learn that there are already some 500 motor-cars running in Sydney and suburbs, and nearly 1,000 altogether in New South Wales. The New South Wales Government and sundry private companies are also establishing motor-'bus services. There are also about 400 motor-boats on Sydney Harbour and the adjacent waters, and the New South Wales Motor-boat Club possesses about 140 active members. This will show how motoring is catching on there and what an opening there is for exporters.

Swiss Customs Tariffs.—New Customs tariffs have been in force in Switzerland since the beginning of the year. The principal alterations refer to the following articles:—Carbons for electric lighting are taxed 6 fr.; motor-cycles 12 fr. a-piece; dynamo-electric machines and electric transformers 5 to 14 fr.; cables of different kinds, 12 to 18 fr.

Tank and Flue Contracts.—Messrs. Thomas Piggott and Co., of Birmingham, have recently secured orders for 20 pressed steel standard tanks for Buenos Ayres, a riveted steel chimney, 6 ft. diameter × 125 ft. high, pressed culvert pipes 36 in. diameter, for South Africa, and riveted rectangular flues for Newcastle power station.

Bankruptcy Proceedings. — Robert Pries.—The public examination was held on January 26th before Mr. Registrar Brougham at the London Bankruptcy Court, of Robert Pries, lately trading in partnership as Durtnall & Pries, electrical engineers, at 82, Bunhill Row, E.C., and Stour Street, Canterbury. The statement of affairs shows liabilities £1,289 10s. 10d., against assets £28 3s. 11d. Replying to Mr. Walter Boyle, Assistant Official Receiver, the debtor stated that he came to this country from Germany in April, 1894. Being without capital he worked as a mercantile clerk until October, 1901, when he joined Mr. Durtnall in partnership, paying £250 for a half share in the business. The money was given to him by his father, who subsequently provided a further £600, all of which went into the business. It was insolvent when witness became a partner, but the capital that he introduced put it on a sound footing. They traded at Bunhill Row and Canterbury until April, 1902, when there was a dissolution of the partnership. Mr. Durtnall had overdrawn to the extent of £151, and witness gave him the alternative of retiring from the firm or having proceedings against him instituted. The former course was chosen, and the debt was forgiven upon Durtnall's leaving the business. In October, 1903, witness sold the Canterbury business for £250 and put the money into the London account. In 1902 and 1903 he made a net profit of £250 a year on the trading. His troubles commenced in the early part of 1904, when, owing to violent competition and the cutting of prices, business dropped off and profits dwindled away. In September, 1904, he took larger premises at 75, City Road, E.C., at a rent of £225 per annum. He had only paid £68 for the Bunhill Row premises but he was given to understand that he could sublet a portion of 75, City Road for £180, which would leave him the ground floor and basement at a net rent of £45 a year. The only sub-rent that he received, however, was £20 for a six months' tenancy of a third floor. Creditors began to press in the spring of 1905, and negotiations for a partnership came to nothing. A judgment was obtained by a creditor in June, whereupon he closed the business and consulted a solicitor, who advised a deed of assignment. The judgment creditor on June 8th levied execution, and seized and sold off the stock and effects. Stock which had cost over £600 was sold for £200; the landlord got £110 and costs, and the remainder was paid into Court for the benefit of the judgment creditor. That disposed of the whole of his assets. A petition was presented by a creditor on July 1st, but a few days later witness went to Germany. His father died there on July 9th, leaving the business to the widow, for whom witness had since managed it at a salary of £7 10s. per month. He was interested to the extent of £70 or £80 in his father's estate, but it was only payable after the death of his mother. This was his first failure. The examination was concluded.

H. J. C. Somerville.—At a sitting of the London Bankruptcy Court held on Tuesday, before Mr. Registrar Linklater, Henry J. C. Somerville, 109, Victoria Street, Westminster, engineer and adviser on patents, attended for public examination upon accounts showing total liabilities £4,875 13s. 10d. (unsecured £4,190 12s. 4d.), and assets valued at £1,200 18s. 6d. In the course of his evidence, the debtor said he had assisted in the promotion of several limited companies. Among the number was the Otto Electrical Manufacturing Co., Ltd., which he promoted in March, 1904, jointly with Mr. J. Deakin and Mr. Otto Gross, to exploit the Otto flame lamp. The nominal capital was fixed at £10,000. A manufactory was established at Manchester with £5,000 supplied by Mr. Deakin. Witness acted as a director at a salary of £50 a year, and for his services in the promoting he received 2,448 shares. A Mr. Jenkins subsequently obtained an option to purchase the assets for £10,000 in cash, and £15,000 in shares. He paid a deposit of £1,000, which was given to Mr. Deakin, but the arrangement went no further. The original company was still in existence, but witness had no interest in it, he having disposed of all his shares. Since the beginning of 1905, he had been without occupation, and practically without income. In July he was sued by Messrs. Maple & Co. for the cost of furnishing and decorating his houseboat, and in October he was made bankrupt. The examination was concluded.

W. Leslie.—At the Wandsworth Bankruptcy Court, on 25th ult., William Leslie was brought up in custody from Brixton Prison to undergo his public examination. He refused to answer questions about his salary as engineer at the Grand Theatre, Fulham. The hearing was adjourned.

Book Notices.—*Baku: an Eventful History.* By J. D. Henry. London: Archibald Constable & Co. Price 12s. 6d. net.—The reviewer lays down this book with a sigh at its remarkable stratification. Part I., which deals with "the origin, progress, and present position of the Russian petroleum industry," might have been summarised as "the rise of the industry." Part II. does not need editing so far as its title goes, which is "the rising in the Caucasus." Part III. is concerned with Batoum. The line of division between the strata is clearly marked. Taking Part I. as the primary, we have in these pages a sequel to Mr. Charles Marvin's "Region of the Eternal Fire," which we read in our more impressionable days. Since its publication much has happened, for instance, the projects of Skobeleff are as dead a document as the death warrant of Charles Stuart, and, still more important, petroleum, which Marvin regarded chiefly from its applicability to boiler furnaces, now stands in a vastly different category to the engineering world by reason of the development of the internal combustion engine. Those who want to know more about the growth of this industry than was prophesied by Marvin, or is related in the "Encyclopædia Britannica," cannot do better than delve into the primary and tertiary strata of this book. It is ably written, not overburdened statistically, and goes into historical detail. The secondary stratum savours too much of the epistles of a special correspondent from a scene of grim horror. Bald and bloody, it tells of fantastic self-mutilation, of organised massacre and rapine, of bitter racial conflict and recrimination. Not that the recrimination counts for much, but the stories of random street shooting, sacking of houses, of men defending their homes till the last cartridge had gone, and of the deaths which followed, are not nice. And after one indiscriminate massacre was ended, with the dead arranged along the sides of the streets, the reader takes note of the two rival races joining arm in arm and dancing. The tertiary stratum is peaceful, telling of Batoum, the Black Sea oil-port of the Caucasus, and the building up of the tank-steamer trade. Regarded as a whole, the first and third parts should be read by all who would be well-informed concerning the history and scope of the petroleum industry. The intermediate section may be

regarded as optional, unless the reader is going to reside in or visit that happy region. Personally, the reviewer likes his horrors in the form of avowed fiction, horrors in the form of truth are too horrid even for sandwiching between the sections of what is mainly a technical work of reference.

The Application of Electric Motors to Machine Driving. By Andrew Stewart. Third edition. London: S. Rentell & Co. Price 2s. — A third edition does not call so much for the reviewer's criticism as for judicious praise. The fact that two preceding issues have been through the Press and have been criticised or lauded on their appearance, gives to the careful author opportunity for revision. This little book has a distinct educational value, and while not appealing specially to the engineer, it does appeal to the engineer's clients. The central station engineer seeking a better load-factor can commend different sections to probable consumers. The nature of these may be judged from the following titles of the chapters:—V. Electricity in Iron and Steel Works; VI. Electric Power in Shipbuilding and Engineering Works; VII. Application of Electric Motors to Printing Machinery; VIII. Electric Power in Textile, Finishing and Paper Factories; IX. Electric Cranes and Lifts; X. Miscellaneous Applications; XI. Electricity Tariffs.

Compared with the earlier editions, the present has been brought up to date by dealing with modern types of motors and their gearing. As we have said, the book is an educational one, and may be commended to manufacturers who are considering, or who need to be induced to consider, the merits of electricity for driving their factory machinery.

Die Elektrischen Bogenlampen, Ihren Prinzip, Konstruktion und Anwendung. By J. Zeidler. (Vol. 6 of Electrotechnik in Einzel-Darstellungen). Brunswick: Fried Vieweg & Sohn.—The subject of arc lamps, though evidently lending itself to separate treatment, is usually dealt with in a condensed manner under the general head of electrical apparatus, so that there is certainly room for this little book. It is arranged to suit the requirements of students, and at the same time gives most of the practical information required by those in charge of arc lamp installations. Historical information and descriptions of obsolete lamps are entirely omitted, whilst the construction of modern lamps (especially those of the Allgemeine Elektrizitäts Gesellschaft) is described in detail with the aid of excellent diagrams. The book is divided into four parts:—(1) Principles of action and electrical conditions; (2) construction; (3) light distribution and the use of arc lamps for various classes of lighting; and (4) the installation of arc lamps and their auxiliary apparatus. Under these headings the design and mode of action of series, shunt and differential lamps are fully discussed, and their behaviour as open, enclosed and flame arc lamps, both on direct and alternate current supplies, is considered. The information contained in the book is, on the whole, accurate and up to date, but some of the explanations given, especially in the photometric section, are rather obscure and might be expanded with advantage.

The Caxton Publishing Co. is issuing immediately the first of six volumes on "Modern Buildings; Their Planning, Construction and Equipment." The work will treat systematically of planning, construction, specification writing, quantity surveying, dilapidations, heating, ventilating, electric and gas lighting, internal fittings and decorations, and everything of interest to those associated with the building trades. The general editor is Mr. G. A. T. Middleton, Vice-President of the Society of Architects, who will be assisted by a staff of writers who are experts in their various departments.

"Annual Report of the Director of the Bureau of Standards to the Secretary of Commerce and Labour for the Year ended June 30th, 1905 (U.S.A.)." Washington: By authority.

"Experimental Electro-Chemistry." By N. Munroe Hopkins. London: Arch. Constable & Co., Ltd. 12s. net.

"Electric Power: What it is, and What it can do." By A. W. Marshall. London: Percival Marshall & Co. 3d. net.

"The Physical Review." Vol. XXII., No. 1, January, 1906. Lancaster, Pa., New York and London: The MacMillan Co.

"The School of Mines Quarterly." Vol. XXVII., No. 1, November, 1905. New York: Columbia University.

"L'Année Electrique: Revue Annuelle des Progrès Electriques en 1905." By Dr. F. de Courmelles. Sixth year. Paris: Ch. Béranger. F. 3.50.

"Proceedings of the Engineers' Club of Philadelphia." Vol. XXIII., No. 1. January, 1906. Philadelphia: The Club, 1,122, Girard Street.

"An Economical and Technical Study of the Mechanical Traction of Boats on Rivers, Canals and Lakes." By St. J. Clark and L. Gérard.

"Electric Hauling of Boats: Notice of the Tests relating to Proportional Adhesion Tractors." By L. Gérard.

Messrs. Archibald Constable & Co., Ltd., have ready for publication during February the following new books:—The second volume of "Motor Vehicles and Motors," by W. Worby Beaumont; "Tunnel Shields and the Use of Compressed Air in Subaqueous Works," by Mr. W. C. Copperthwaite, M.Inst.C.E., one of the engineers to the London County Council. The work contains over 250 illustrations and diagrams; "Modern Turbine Practice and Water Power Plant," by John Wolfe Thurso; "The Seven Follies of Science," by Mr. John Phin, editor of the Marquis of Worcester's Century of Inventions and the Workshop Compendium; a new book by N. Munro Hopkins on "Experimental Electro-Chemistry," for use in the lecture room and the laboratory; a new edition (15th) of "Gas Gasolene and Oil Engines," by G. D. Hiscox, containing a special section on gas producer plants; a second and revised edition of Mr. Bertram Blount's standard book on "Practical Electro-Chemistry."

Calendar. — Messrs. Hobdell, Way & Co., Ltd., engineers' furnishers, 65, Crutched Friars, E.C., have issued a hanging wall calendar with monthly slips. Illustrations of a number of their specialities appear on the card.

LIGHTING AND POWER NOTES.

Ashington.—A failure in the E.L. supply to the town occurred on Saturday last.

Barking.—The U.D.C. has resolved, as an experiment, to charge for E.L. in artisans' dwellings as follows:—Buildings containing two lights, 4d. per week; ditto, four lights, 6d. per week. This is in place of slot meters.

Acting on the advice of the electrical engineer (Mr. H. L. Howard), the U.D.C. has decided to discontinue the execution of repairs to wiring and the supply of fittings by the department to private consumers, and has instructed Mr. Howard to prepare regulations for the wiring, &c., of consumers' premises by contractors.

Birmingham.—The Electric Supply Committee has recommended the T.C. to adopt a scheme whereby electric motors and starting switches can be supplied on the hire system. Under the scheme the committee do not propose that any wiring work shall be carried out by the department, so that the work of this character will fall largely into the hands of the wiring contractors in the city. Hirers will, however, be given an opportunity to purchase motors.

Brighton.—The borough accountant has presented a report in reply to criticisms upon the financial methods adopted in connection with the municipal electricity undertaking, and states that "the fact that over £110,000 has been provided for debt repayment makes absurd the criticism that no provision had been made for depreciation."

Durham County.—At the meeting of the C.C. on January 24th, the Electricity Supply Committee submitted a report dealing with 182 municipal electricity undertakings, which stated that local authorities charged consumers 1·10d. per unit less than private companies, while the working expenses were ·54d. less per unit. It was further reported that Mr. J. E. Hodgkin, of Darlington, had offered to confer with the Committee with a view of making an investigation and reporting upon the practicability of a county scheme, without fee, and this offer was recommended for acceptance. Alderman Samuel opposed the acceptance of the offer, and advocated the payment of some expert selected from the open market. On a division, the recommendation of the Committee was rejected by 27 votes to 17.

Edmonton.—The U.D.C. proposes to transfer its prov. order to the North Metropolitan Electric Power Supply Co. Notice to this effect appears in the *London Gazette* for January 26th. The consideration money is £2,800.

Gillygair.—Providing a prov. order for E.L. is obtained, the U.D.C. has decided to negotiate with the Powell-Duffryn Co. with a view to arranging terms for a supply of energy for public lighting at Bargoed. The E.L. Committee has also been asked to negotiate with the Rhymney and Aber Gas Co. who, it was stated, would withdraw their opposition to the E.L. scheme on the introduction of certain clauses.

Glasgow. — The Electricity Committee, having considered the remit made to it by the T.C. to reconsider its decision as to the new boilers required for the Port Dundas and St. Andrew's Cross generating stations, has agreed to recommend that the whole contract for the ten boilers be given to Messrs. Babcock & Wilcox. The former decision has been re-affirmed.

Grimsby.—A L.G.B. inquiry was held on January 25th into the Corporation's application for a loan of £18,000 for extensions of E.L. plant, buildings, cables and mains. The extensions are needed to enable the Council to supply energy to the Great Central Railway Docks. There was no objection, but the inspector emphasised the necessity of creating a reserve fund, pointing out that it not infrequently happened that the revenue-earning capacity of plant had ceased before the plant itself was actually paid for.

Horley.—The B. of T. has written to the Reigate R.D.C. intimating that as the requirements of the Horley E.L. Order, 1904 (which was transferred to the Horley Electricity Supply Co.) have not been complied with, the Board proposes to revoke the order. As the matter is a private one, the Council has decided to take no steps.

Ilford.—The U.D.C. has received from the L.G.B. sanction to a loan of £5,000 for E.L. purposes.

India.— Calcutta.— There seems, from the frequent expressions of the Indian Press, to be much dissatisfaction on the score of the cost of E.L. and power supply in Calcutta. The rates, we believe, are 8 annas per unit for lighting, and 4 annas per unit for power, subject to rebates for quantities. The report for 1904 issued in April last, gives the total number of units sold during the year as 2,760,457, and the gross revenue at £60,243, which is about 5·23d. per unit sold. A Calcutta paper says that the City Corporation will shortly be asked to consider a new agreement

which the Government proposes to make with the Supply Corporation, in abrogation of all previous licenses, and expresses the hope that such an opportunity will not be passed for making better terms for the public.

Leyton.—The U.D.C. has decided to ask other Councils to co-operate in calling the attention of the Government to the unnecessary expense imposed upon local authorities by the omission to insert in private Bills the "necessary" protection clauses. It is suggested that power should be given to charge companies which neglect to insert these clauses, with the expense to which their omission puts the municipal authorities.

London.—CITY.—The City of London Electric Light Co. has applied to the Public Health Department of the Corporation for permission to carry out, at its own expense, some lighting experiments, to demonstrate the superiority of electricity over gas. The thoroughfares selected by the company are Newgate Street, Holborn, New Bridge Street and Farringdon Street. It is to be hoped that the Committee will assent to the company's proposal.

BATTERSEA.—On the recommendation of the electrical engineer, it has been decided to expend £1,935 on new plant to cope with the demand during next winter.

WESTMINSTER.—On the 27th ult., at the Surveyors' Institution, Westminster, Sir Edward Boyle, K.C., M.P., sat as arbitrator in a case between the L.C.C. and the Westminster Electric Supply Corporation, arising out of the L.C.C. Improvements Act, 1900. For the company it was explained that the claim put forward by the company was connected with the Westminster improvement. The company had a generating station in Millbank Street with a river frontage, and it was necessary for that station to be removed in order to make way for the improvement. In authorising the improvement, Parliament inserted a clause in the Act imposing on the C.C. an obligation to reinstate the company's station on a site equivalent in all respects to the site of which the company was being dispossessed. A new site had been offered by the C.C. in Horseferry Road, and the question which the arbitrator was asked to determine was whether that site was equivalent to the old one. It was submitted that the onus of proving that it was equivalent, was on the L.C.C., and that, therefore, it should open the case. The site offered was slightly larger—by 694 sq. ft.—than the old one, but the area was not the only question to be considered. Situation had to be taken into account, with the question whether the company could conduct its business with as great facility and the same capacity as before.

Sir Edward Boyle decided that the company must open the case and state its objections to the suggested site. Witnesses were called who criticised the site in detail, and the arbitration was adjourned.—*Globe.*

MARYLEBONE.—The B.C. Electric Supply Committee on Tuesday last, reported on the financial position of the undertaking on December 31st. With regard to the amount required to pay the award, &c., to the Metropolitan Electric Supply Co., and the expenses in connection therewith, Mr. Wright, the consulting engineer, estimated it at £1,378,692. The total net estimated expenditure is now, however, £1,415,876, or an excess of £37,184. Mr. Wright's first estimate was made before the long delays occurred which rendered it a matter of impossibility to prevent the Metropolitan Co. expending large sums which have been of little value to the borough. Another question of expenditure was for erecting a generating station and changing over the supply from 100 to 240 volts. This Mr. Wright estimated at £540,600, but the actual expenditure is now estimated at £587,662, or an increase of £47,062. This the Committee stated to be caused chiefly (£41,000) by the increase in the cost of change of pressure. Another factor in the increase is the probable bonus (£6,552) which will be earned by the turbine contractors (Messrs. Parsons) owing to the greater efficiency of plant. The advance in the price of copper at the time of the acceptance of the feeder contracts is stated to further account for the increase in the estimate, as did also the cost of providing special mains to take over a large area in bulk, instead of in small sections, as originally intended. On the total figures the estimates under both divisions of expenditure had been exceeded by £84,246, and, adding £38,500 for site, £122,746. It will therefore be necessary to increase the capital charges by the sum of £7,110, and also to add 1½ per cent. depreciation charge on new plant (£47,062). This will make a charge for capital and depreciation of £7,815 per annum more than was estimated. The Committee has "no doubt that the Council will save at least ½d. per unit in the cost of generation, which will amount to a saving on Mr. Wright's estimates of £15,200 a year. Sanction will be required from the L.C.C. for £151,162 to complete the scheme. An arrangement has been entered into with the Hampstead B.C. for the exchange of E.L. areas, so as to make them co-terminous with the boundaries of the respective boroughs.

L.C.C.—The Stepney B.C. is endeavouring to get the C.C. to drop its bulk supply Bill and to support the private Bills in the House.

It has been resolved to seal petitions for presentation, if necessary, against several underground railway Bills, tramway Bills, and electric supply and power Bills.

The Theatres and Fire Brigade Committees have brought forward a joint report in regard to the inspection of theatres and other places of amusement. It was suggested that a re-arrangement should be made whereby the chief officer of the fire brigade should in future be responsible for the inspection of electric lighting installations and heating and other mechanical appliances in theatres, that two officials from the engineer's department should be transferred to the fire brigade, and that an electrical and mechanical engineer, at a salary of £400 a year, and an electrical engineer at £200, should be advertised for and attached to the fire brigade. In the course of their report, the Theatres Committee stated:—

As regards the inspection of the E.L. and heating arrangements in places of public entertainment, for which at present the chief engineer is responsible, the Committee thinks that this also should be placed under the control of the chief officer of the fire brigade, so that the number of departments concerned in the inspection of places of entertainment may be reduced to two. At present the staff of the engineer's department which is constantly engaged on this work, and whose salaries are charged to the theatres account, consists of one first-class and one second class, assistant engaged on the inspection of E.L. installations, and one first-class assistant engaged on the inspection of heating apparatus and other mechanical arrangements. In addition, a portion of the time of Mr. Gunyon, principal assistant in the highways, E.L., &c., branch of the engineer's department, is occupied by the E.L. work, and of Mr. Rounthwaite, the mechanical engineer, by the heating work and work in connection with lifts and other mechanical apparatus.

The chief engineer, who has been consulted on the matter, stated that in view of the additional work that had been recently cast on Mr. Gunyon and Mr. Rounthwaite in connection with the educational and other new work performed by the Council, he would be glad for these officers to be relieved of this work in connection with theatres, &c. The additional work referred to, made it impossible for him to spare more than one of the inspectors engaged on the electric lighting work, but if the theatre work were not taken over by the chief officer of the fire brigade immediately, arrangements could be made for any new men appointed to receive some preliminary training in his department. The chief engineer suggested that the following staff would be required by the chief officer of the fire brigade:—One electric lighting and mechanical engineer to take charge of the section under the chief officer of the fire brigade, at a salary of about £400 a year. One electric lighting inspector (salary £245 a year) to be transferred from engineer's department. One electric lighting inspector (salary £200 a year) to be newly appointed. One heating inspector (salary £230 a year) to be transferred from the engineer's department.

During the past few years there has been a great increase in the use of electric lighting in places of public entertainment. The Committee feels strongly that the responsibility of the Council for taking every reasonable precaution to ensure the safety of the public, makes it imperative that the electric lighting and heating installations at all places of public entertainment should be periodically and systematically inspected, and under the existing arrangements it has not been possible to do this as fully as it should be done.

The Fire Brigade Committee acquiesces in the suggested re-arrangement, provided it has the staff which the chief engineer suggested would be necessary.

Middlesex.—The C.C. has concluded that in the E.L. supply orders of the various local authorities in its area, its interests are protected. The C.C. has received intimation that the Edgware E.L. scheme is not to be proceeded with. The Additional E.P. Supply (London), the L.C.C., the Metropolitan Co.'s, and the Twickenham and Teddington Co.'s Bills are to be opposed with a view to the insertion of certain clauses.

Newark.—The T.C. on Monday decided to oppose certain clauses of the Bill of the Nottinghamshire and Derbyshire Electric Power Co.

Plymouth.—The Electricity and Street Lighting Committee has decided by a narrow majority to recommend the T.C. to reduce the price of energy for the tramways from 2d. per unit to 1¾d.

Rowley Regis.—With the object of securing satisfactory terms, the U.D.C. has decided to oppose the Bill being promoted by the Shropshire, Worcestershire and Staffordshire Electric Power Co. Handsworth U.D.C. will also oppose the Bill.

Scottish Notes.—In reference to our note on p. 103 of 19th ult., Messrs. Arch. Watson & Co., of Glasgow, state that the Fairfield Co. are only following the lead of Messrs. Barclay, Curle and Co., for whom they fitted up an installation of electric drills, arc lamps, &c., some four months ago in the same dock, for the repair of the Allan liner *Victorian*, which after going aground in the St. Lawrence was towed to Glasgow. The repair was completed some two months ago, and power was taken by temporary connection from the Govan Corporation supply. The installation was inspected by many of the leading shipbuilders on the Clyde, and its advantages were so pronounced that it induced the Fairfield Co. to follow the lead.

South America.—BAHIA BLANCA.—The municipality has come to an arrangement with the E.L. Co. whereby the supply of energy will be resumed and the undertaking overhauled and repaired. In case of storms, the municipality has authority to suspend supply so as to prevent accidents by the falling of the overhead wires.—*Review of the River Plate.*

A correspondent states that the Companhia Transatlantica Alemana de Electricidad, of Buenos Ayres, has applied to the municipality for a concession for erecting electricity works for lighting and power purposes. The application has been transmitted to the Commission of Public Works for report, and it is believed that the concession will be granted.

Stourbridge.—The B. of T. has deferred consideration of the question of revoking the Council's electric lighting order for six months.

Southampton.—On the recommendation of its electrical engineer, the T.C. has resolved to apply to the L.G.B. for permission to borrow £2,000 for storage batteries and extension to the switchboard. Regarding extra plant to meet next winter's load, Mr. Street mentions a 500-KW. set, similar to those now installed, and a steam turbo-generator of 1,000-KW. capacity. The cost of the former set, with accessories, he estimates at £7,000, and the latter at £10,200, and states that he is of opinion that the horizontal reciprocating engine would be best from an engineering point of view, and also more efficient as regards coal consumption, in spite of the contention of turbine makers to the contrary. New boiler plant will not be necessary. This question has, however, been left in abeyance.

Stoke-on-Trent.—As an experiment the T.C. has decided to fix a small number of penny-in-the-slot electricity meters in cottage property.

Thornaby-on-Tees.—The T.C. on the 29th ult. agreed to seal the deed of transfer of the E.L. order from the Corporation to the Cleveland and Durham County E.L. Co., which had been provisionally approved by the B. of T. The company is to pay the Corporation £200 to cover its expenses in connection with the order. The Corporation reserve the right to purchase on certain terms.

Wellingborough. — The R.D.C., on January 24th, unanimously decided to assent to the application for an E.L. prov. order being made by the County of Northampton E.L. and Power Co., the Parish Councils affected having signified their approval of the scheme. Rushden Council has declined to assent to the application.

A further report on the substitution of gas for E.L. was presented to the U.D.C. recently by its Committee, and it has been decided that the Northampton E.L. Co. "be given the work of disconnecting the present lighting leads from the cables."

TRAMWAY AND RAILWAY NOTES.

Ashton.—Trouble is threatened in connection with the Ashton-under-Lyne Corporation electric tramways. Some weeks ago a driver was discharged for alleged negligence in connection with the trolley pole of his car leaving the overhead wire and breaking one of the guard wires. The man was reinstated after pressure by the Amalgamated Association of Tramway and Vehicle Workers. Another driver has since been discharged for the trolley pole leaving the wire and striking a railway bridge. The Union again made efforts to have the motorman reinstated, saying it was not his fault, and the officials refused, and at midnight on Saturday a mass meeting of tramwaymen was held at the Corporation Hall, Hurst, at which a resolution was passed that if the motorman was not reinstated, the men would give in their notices to cease work. A deputation was appointed to wait on the Tramways Committee.

Bath.—On Friday the Light Railway Commissioners held an inquiry into the application of the Electric Tramways Co., Ltd., for powers to extend their system from Newton St. Loe to Saltford, a distance of about 1½ miles, at an estimated cost of £17,000. Opposition was offered by the County Council and the Keynsham R.D.C. on the ground that there was no public necessity for the extension, and that with tramways the cost of road maintenance increased from 25 to 30 per cent. Subject to all reasonable protections the Commissioners granted the order.

Birmingham.—A L.G.B. inquiry was held last week by Mr. H. R. Hooper, into an application by the Corporation for power to borrow £132,690. It was explained that the main reason for additional expenditure was the development of the tramways system. In 1903 the Corporation took over about 33 miles of line. Since then additional powers had been obtained, and in the course of the next 18 months there would be about 64 miles of tramways within the city. The whole of those lines with the exception of seven miles, the leases of which would not expire until 1911, would have to be worked by the Corporation in about 18 months. The additional sums for which power was asked to borrow were for the purpose of laying down plant to meet the tramway requirements and for a further station at Saltley.

Bradford.—The Corporation has decided to establish a motor-car depôt for the supply of all cars needed for the Corporation service, and the Tramways Committee is to have the working and control of this depôt.

Continental Notes.—GERMANY.—The Berlin municipal authorities have held a conference with the authorities of eight suburban towns, and decided to take the initial steps towards acquiring the property of the Berlin Tramway Co., which has practically a monopoly of the public conveyance in Berlin and possesses a capital of 100 million marks.

ITALY.—A meeting was recently held to discuss the question of the construction of an electric railway from Montesilvano to Peune, which should be of immense value to the population of the Valle del Tavo. It was unanimously decided to address a formal application to the Italian Government for the maximum subsidy per kilometre (decided by the law of December 4th, 1902) for the construction of this line.

Chester.—The T.C. has decided to obtain tenders for the work in connection with the extension of the tramways in Boughton and along the Tarvin and Christleton Roads, and to purchase for use on the present system a demi-car, fitted with the new regenerative control appliances, at an approximate cost of £520, such car to be subsequently used as one of the four new cars required for the Boughton extension.

Croydon.—What were understood to be the final offers of the B.E.T. Co. for the renewal of the lease of the local tramways came before the Croydon Borough Council on Monday evening. Having been lessees about six years, the B.E.T. now asked if they could buy up the whole undertaking at the net capital cost to date, viz., £239,424. This represented a cash advantage to the Council of the amount so far paid off in interest and sinking fund, and, with other sums to the good, totalled an immediate benefit of about £45,000. Further, subject to certain agreed charges, the company offered the Council half the net profits, and would undertake to allow it to re-acquire the system in 25 years' time, if desired, at fair market value. Among other things, the company were willing to allow the Council the right to insist on "reasonable" maintenance, repair and renewal. One concession asked was to be allowed to put advertisements upon the cars under restrictions similar to those enforced by the L.C.C. The Tramways Committee recommended that these terms be not accepted. Sir Frederick Edridge moved the acceptance of the terms, and, while admitting that the B.E.T. had made a profit out of the Croydon trams, declared that they had put nothing aside for renewals. He urged the advantage of an assured income, and pointed out that the immediate benefit of £45,000 would enable them to put the borough finances on a sounder footing. The arguments on the other side were voiced with vigour. A general distrust of the B.E T. was shown, notably regarding their returns as to profits made in Croydon. Again, it was used as an argument both for and against that the B.E.T. had schemes on hand for running cars to Croydon from Penge (under construction), Mitcham and Sutton. On one hand this fact was brought out as showing that Croydon held the key to the position, and should keep it, while, on the other hand, it was contended that the company could never have made such liberal offers but for the linking up with the outside systems—in other words, that if they ran the Croydon trams at no profit, the connections with outside districts would make that up. The most was also made of the reported difficulties which public bodies had had with the B.E.T. in other parts of the kingdom. At the end of a protracted debate, the offer was rejected by 42 votes to 7. The second offer considered was on the lines of the existing lease, but with much improved terms for the Council. It was for a 7, 14 or 21 years' lease, the company paying 7 per cent. on the capital expenditure instead of 6½ per cent. as hitherto, and guaranteeing the Council a quarter of the net profits. In connection with the latter, the Council was to be empowered to appoint a chartered accountant to inspect the company's books and accounts. There were other favourable terms of a minor character. An amendment that further negotiations should take place was lost, after it had been pointed out that the Council could not afford to delay its final decision any longer. On a direct motion, this second offer was rejected by an overwhelming majority. Therefore, as the matter at present stands, the company will give up possession on May 31st next, and the Tramways Committee of the Borough Council will become solely responsible for the management and working of the system.

Dublin.—The Judicial Committee of the Privy Council has granted an application by the Dublin United Tramways Co. for an extension of the time for completing tramway No. 13 for a period of three months.

East Ham.—Notice has been served by the T.C. upon the North Metropolitan Tramways Co. requiring them to sell to the municipality their undertaking. The engineer of the Council was authorised on Tuesday to duplicate the track in the Aldersbrook Road.

Johnstone.—Negotiations are taking place between the T.C. and the Paisley Tramway Co. for the extension of the system to the burgh boundary.

Liverpool.—Colonel von Donop was to hold an inquiry at Liverpool yesterday, with regard to the recent tramway accident.

Llandudno.—It is reported that a London firm of engineers has undertaken to complete the light railway, provided Sunday running is permitted.

London.—L.C.C.—The B. of T. inspection of the new L.C.C. electric tramway route from the Marquis of Granby, New Cross, to the Obelisk, Lewisham, took place on Saturday, and the tramway was opened for public traffic on Tuesday this week.

CITY AND SOUTH LONDON ELECTRIC RAILWAY.—On Thursday last week a breakdown occurred on one of the locomotives of the above railway, owing to a short-circuit in one of the motors. The lights were extinguished, and smoke entered the carriages, but no great harm was done. The *Daily Mail* reports that the driver and stoker bravely remained at their posts!

Motor-'Bus Fires.—There has been an epidemic of fires on motor-'buses lately—one on Tuesday and one on Thursday last week in London (besides a collision with an arc lamp standard), a third in Birmingham, and a fourth in London, on Tuesday last. The petrol motor is a "fiery steed" indeed!

Oxford.—The result of a poll taken on the resolution authorising the Council to electrify and work electric tramways resulted as follows:—For, 1,117; against, 5,092.

Rochdale.—The question of the payment for meal times is in dispute between the Rochdale Corporation and the drivers and conductors. In 1903 the Tramways Committee allowed the men on the cars 20 minutes' relief during each shift, paying for this at the same rate as the ordinary hours worked. On some sections, notably Littleborough, the time was extended to as much as 50 minutes. Now the Committee wishes to bring them all into line, and to allow 20 minutes only. The men say they want a uniform rule of 40 minutes. The Corporation replies that it pays 5¾d. per hour against 5d. in Oldham, Bury and other places for conductors; the average paid is 5¼d. For drivers the general rate works out at 6¼d., and this the Corporation pays. With the exception of Leeds, Burnley, Birkenhead and Bradford, where a 20 minutes' relief is paid for, the whole of the tramway authorities in the United Kingdom require conductors and drivers to take their meals on the cars while the service is being run. It is pointed out by the Corporation that the payment of 40 minutes' relief would mean an extra cost of several hundred pounds a year to the ratepayers, and the Committee has decided to pay for 20 minutes only. The committee of the men's union has been instructed to call a mass meeting to consider the question.

Tyneside.—The total traffic returns of the Tyneside Tramways and Tramroads Co. for the 12 months ended December 31st last amounted to £21,410, an increase of £1,237 over 1904.

TELEGRAPH AND TELEPHONE NOTES.

Edison Telegraph Patents.—A Laffan dispatch in the *Daily Telegraph* states that a lawsuit which has lasted nearly 30 years was recently decided in favour of Mr. Thomas A. Edison who was awarded damages and arrears of payments amounting to many millions of dollars for the use of certain of his patents. It appears they were sold to Mr. Jay Gould on a royalty basis for the use of the parent of the present Western Union Telegraph Company. Mr. Gould, it is stated, never kept his promise to pay royalties. The Judge has now ordered an account to be rendered, and the company's books will have to be examined to ascertain the number of instruments used, if the company will not settle for a lump sum.

Frankfort-Vienna Telephone.—The trunk telephone line between Vienna and Frankfort is now completed, covering a distance of 512 miles. The line passes through the territories of three Governments.

Lord Stanley and the Telegraphists.—We are pleased to see that a Post Office circular has been issued to the following effect:—"It has been brought to the notice of the Postmaster-General that on a particular occasion during the recent elections a demonstration of feeling, apparently of an organised character, took place in the Central Telegraph Office and some other offices on the 19th ult. Mr. Sydney Buxton regards such action by officers of the Post Office on duty and in Post Office buildings as unseemly and derogatory to the dignity of the service, and desires to express his regret that it should have occurred and his disapproval of it."

New Pacific Cable.—The first section of the new Pacific cable has just been successfully laid. The cable steamer *Faraday* recently arrived at Iquique from Valparaiso, having completed the laying of the first portion, which is 911 miles in length. The cable will be continued from Iquique to Churrillos, in Peru, a further distance of 770 miles.

Norway.—Mr. T. Heftyl has been appointed by the King of Norway to succeed Mr. Rasmussen, deceased, as Director-General of Posts and Telegraphs.

River Plate.—The La Plata Government has authorised the United River Plate Telephone Co. to extend its lines in various directions, a total of 400 kilometres to be terminated within five years.—*Review of the River Plate.*

Spain.—The King of Spain has signed a decree opening a credit for the laying of a cable from Cadiz to connect Spain with the Canaries.

Venezuela.—According to Reuter's dispatches, General Matos, the leader of the recent revolution in Venezuela, has stated his belief that the present situation would not lead to any serious complications with France, and that the French Cable Co. would be able to come to some arrangement with the Venezuelan Government. At present it appears uncertain whether France will take any speedy action while the Algeciras Conference is in sight. Although the employés of the Cable Co. have left Venezuela, the company, it appears, still carry on their business, and announce that they will accept messages for Venezuela at usual rates, and with code addresses, or they may be sent to Curacao at rates in force for that place with instructions to post. In either of the above cases telegrams will be sent by almost daily mail opportunities from Curacao to Venezuela, but senders must take all risks. The latest advices announce that the carrying of telegrams from Trinidad to Amacura by Venezuelan gunboat has been stopped, but other opportunities will be availed of.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	..
Dominica-Martinique	May 7, 1902	..
St. Lucia-Martinique	May 7, 1902	..
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	..
Cayenne-Pinheiro	Aug. 13, 1902	..
Port Arthur-Chifu (Closed)	Mar. 7, 1904	..
Jamaica-Colon	Jan. 5, 1905	..
Cadiz-Tenerif	July 20, 1905	..
Tarifa-Tangier	Jan. 18, 1904	..
Puerto Plata-Martinique	Oct. 30, 1905	..
St. Thomas-St. Kitts	Dec. 28, 1905	..
Bolama-Bessao	Jan. 19, 1906	..
Landlines.		
Puerto-Barrios	Aug. 28, 1902	..
Kertch-Soutehoum	Sept. 27, 1904	Jan. 30
Communication with Brazil *via* Galveston	July 18, 1905	..
Communication with Alaska *via* Seattle	Jan. 17, 1906	..
Rome-Constantinople	Jan. 25, 1906	Jan. 27

Wireless Telegraphy.—The last Post Office circular publishes conditions on which telegrams may be accepted from the public for transmission to ships of H.M. Navy as from February 1st next. The name of the wireless station will in each case pass as one word in the address. The word "Radio" is sent as a service instruction, and is not charged for. Telegrams must still only be accepted at sender's risk without chance of claiming refund, and in the last paragraph it is stated that "any person desiring to dispatch a telegram for transmission to a ship of the Navy or the mercantile marine from the Marconi Wireless Telegraph Co.'s long-distance station at Poldhu, should be advised that it is necessary for him to make arrangements with the company to that effect. The company's address is 18, Finch Lane, London, E.C." It would appear from this as if the Postal Telegraph authorities do not now accept long-distance wireless telegrams, the acceptance of which was notified on January 31st, 1905.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barnes.—February 12th. Steam dynamo and switchboard panels for the U.D.C. See "Official Notices" January 19th.

Battersea.—February 5th. One 750-850 or 1,000-KW. generator with piping and ejector condenser; arc lamps, globes and columns, for the B.C. See "Official Notices" January 12th.

Belgium.—The State Railways will shortly invite tenders for the installation of the electric light in the station at Esschen, and for the supply of apparatus for the electric lighting of trains. Apply *re* conditions to Bureau des Adjudications, Musée Commercial, Rue des Augustins, Brussels. Some particulars are also given in the *Board of Trade Journal.*

Blackburn.—February 12th. Stores for the Electricity and Tramways Committee. See "Official Notices" January 26th.

Cardiff.—February 16th. Cooling towers, electrically-driven pumps, pipe work, &c., for the Corporation Roath Power Station. See "Official Notices" January 26th.

Cheltenham.—February 3rd. Stores for the Corporation (including electric light fittings). Mr. J. S. Pickering, Borough Surveyor and Water Engineer.

Christiania.—February 9th. Tenders are invited for the supply of telegraph and telephone materials (including battery zinc, insulators, sal ammoniac, retort carbon, &c.) to the Norwegian State Railways. A copy (in Norwegian) of each of the specifications and conditions, together with drawing of insulator, may be seen on application at the offices of the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

Christiania.—February 10th. The Commercial Intelligence Branch of the Board of Trade has received from the Acting British Consul-General at Christiania, detailed particulars relative to the supply of telegraph material to the Norwegian State Telegraph Department, from which it appears that it is open to British contractors to tender for the following:—66,600 insulators; 88 tons telegraph and telephone wire (iron) of different thicknesses; 15,000 metres steel wire rope (7 and 12 strand); and 1,224 metres cable. Tenders from British firms should be lodged, by their properly accredited agents, at the offices of the Telegraph Management in Christiania. A copy (in Norwegian) of each of the speci-

fications and conditions, including forms of tender and drawings of insulators, may be seen on application at the offices of the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C. (NOTE.—Apart from the usual Customs duties, a preference of from 10 to 15 per cent. is given to Norwegian manufacturers.) In all cases of Norwegian Government contracts, it is obligatory that a resident agent should act for tenderers not residing in Norway, and be responsible to the Government, but it is not necessary for the agent to be a Norwegian firm.

Clyde Navigation.—February 12th. Electrical cable and conductor installation for Clydebank Dock. See "Official Notices" January 26th.

Dover.—February 16th. One 350-KW. combined steam generator set for traction purposes for the Electricity Department. See "Official Notices" January 26th.

Germany.—February 16th. The *Board of Trade Journal* says that tenders are being invited for 18 electric cranes at Hamburg. Conditions, for 3 marks, from the Finance Administration, Hamburg.

Pontypridd.—February 13th. One 300-KW. steam dynamo for the U.D.C. See "Official Notices" January 19th.

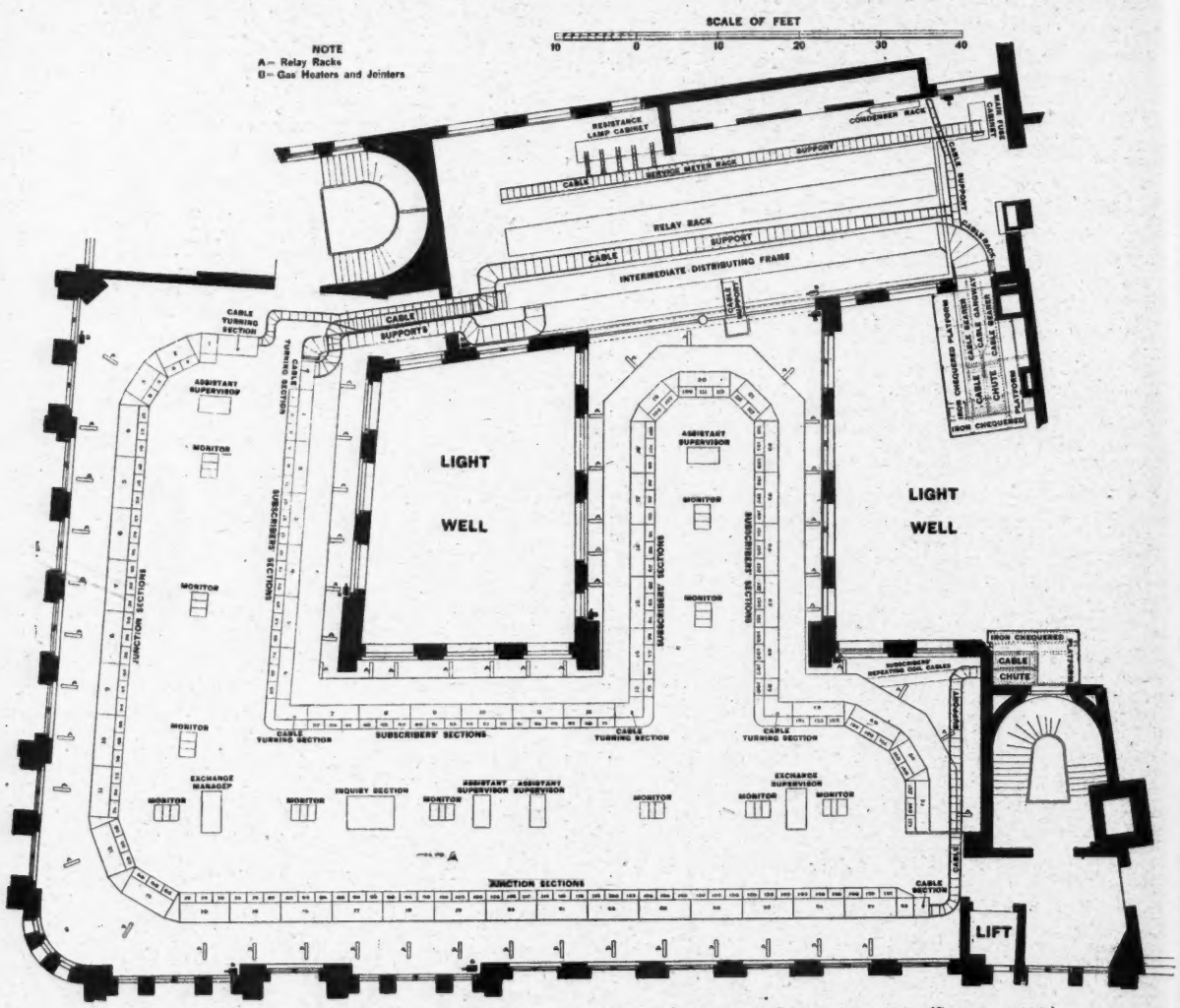
Rathmines and Rathgar.—February 17th. Coals, carbons and general stores for the electricity department. See "Official Notices" to-day.

Salford.—February 17th. Stores, &c., for the electricity department. See "Official Notices" to-day.

Shanghai.—February 22nd. One 800-KW. horizontal steam turbo-alternator with condensing plant, for the Municipal Council. See "Official Notices" January 26th.

Sheffield.—February 19th. Stores for the Corporation Tramways Department. See "Official Notices" to-day.

Spain.—February 20th. The Spanish Post and Telegraph Authorities, in Madrid, are inviting tenders for the supply of 55 tons of galvanised iron wire, 4 mm. dia.; 15 tons of bronze wire



POST OFFICE TELEPHONE SYSTEM.—FIG. 14.—PLAN OF THE "CITY" EXCHANGE, SECOND FLOOR. (See page 182.)

Hammersmith.—February 7th. General stores for the B.C. electricity department for one year. See "Official Notices" January 19th.

Kingston-upon-Hull.—February 12th. Air-space telephone cable and extension of existing multiple switchboard for the Corporation telephone equipment. See "Official Notices" January 19th.

Leyton.—February 15th. Underground electrical feeders for the U.D.C. tramways. See "Official Notices" to-day.

Musselburgh.—One 40-B.H.P. D.C. shunt motor and starting switch for the Wire Mills. See "Official Notices" to-day.

3 mm. dia.; and 5 tons ditto, 2 mm. dia. Particulars may be obtained from, and tenders are to be sent to, La Direccion Général de Correos y Telegrafos, Carretas 10, Madrid.

Sunderland.—March 2nd. Feed pump, cooling tower, surface condenser, coal bunkers, &c., for the Electricity Department. See "Official Notices" January 26th.

Wakefield.—February 17th. Water softening and purification plant for the electricity department. See "Official Notices" to-day.

West Ham.—February 16th. One 1,500-2,000-KW. two-phase turbo-generator, one 500-KW. motor-generator, and switchgear for the same for the Council. See "Official Notices" to-day.

(*Continued on page* 184.)

THE POST OFFICE TELEPHONE SYSTEM.

(*Concluded from page* 144.)

Intermediate Distributing Frame.—The intermediate distributing frame, relay racks, and meter racks form one structure 56 ft. long by 13 ft. wide, but varying in height from 12 ft. 5 in. to 9 ft. The frames are of the standard type of the Western Electric Co., and are remarkable chiefly on account of their great dimensions. Heavier metal than usual is employed in their construction—as far as possible channel iron.

Fig. 15.—General View of the Switchroom of the "City" Exchange During Construction.

As the shelves—of which there are 11—on the horizontal side of the intermediate distributing frame have to bear considerable weight, continuous iron bars are run along their front, in order to stiffen them and preserve their alignment.

Three sets of cables are connected to each of the subscribers' shelves. These consist of the following:—Ten 400-wire lead-sheathed cables carrying the circuits from the main distributing frame, 100 84-wire switchboard cables running to the relay rack with the leads to the line and cut-off relays, and 100 63-wire switchboard cables carrying the subscribers' multiples to the junction switchboard. Upon the other side of the frame are 100 verticals, each accommodating 220 circuits. The cables carrying the subscribers' circuits to the answering positions terminate upon the vertical side of the frame.

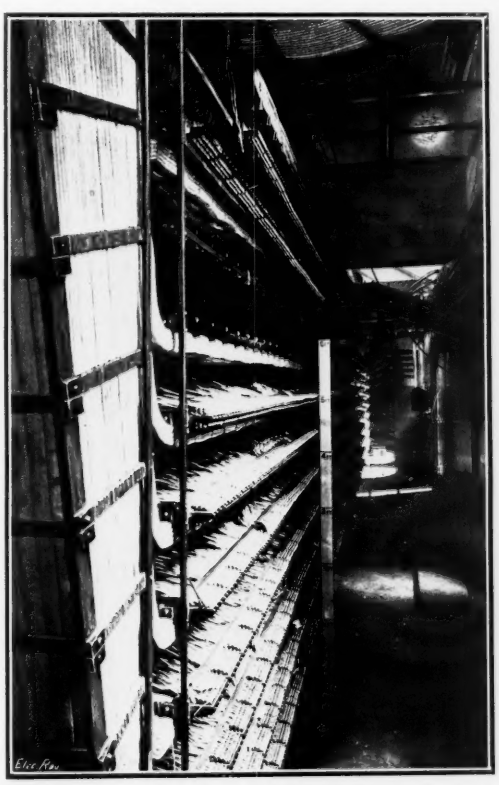


Fig. 16.—Intermediate Distributing Frame.

Fig. 17.—Relay Rack

The distance between the shelves is 8 in., whereas in the Central Exchange frame it is 6½ in. Each of the 11 shelves is fitted with the connectors necessary for the accommodation of 2,000 circuits. Shelves 1 to 9 accommodate the subscribers' circuits, Nos. 10 and 11 providing for the outgoing junction and miscellaneous circuits.

An upward extension of the intermediate distributing frame at its northern end provides facilities for terminating the cables necessary for cross-connecting purposes between the intermediate frames in the Central and City Exchanges.

Relay Rack.—The relay rack, which runs parallel with the intermediate distributing frame, and is in two portions,

F

has a capacity for 19,040 subscribers' line and cut-off relays, as well as 2,720 miscellaneous relays and resistance spools.

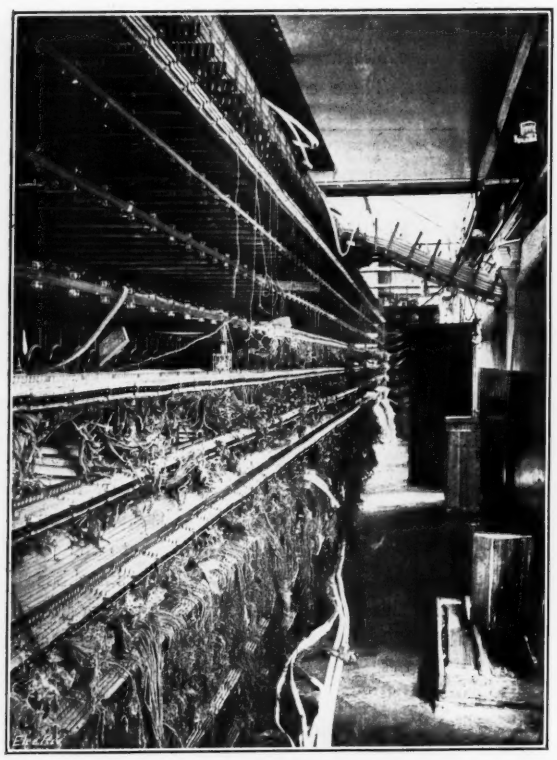


Fig. 18.—Intermediate Distributing Frame (During Construction).

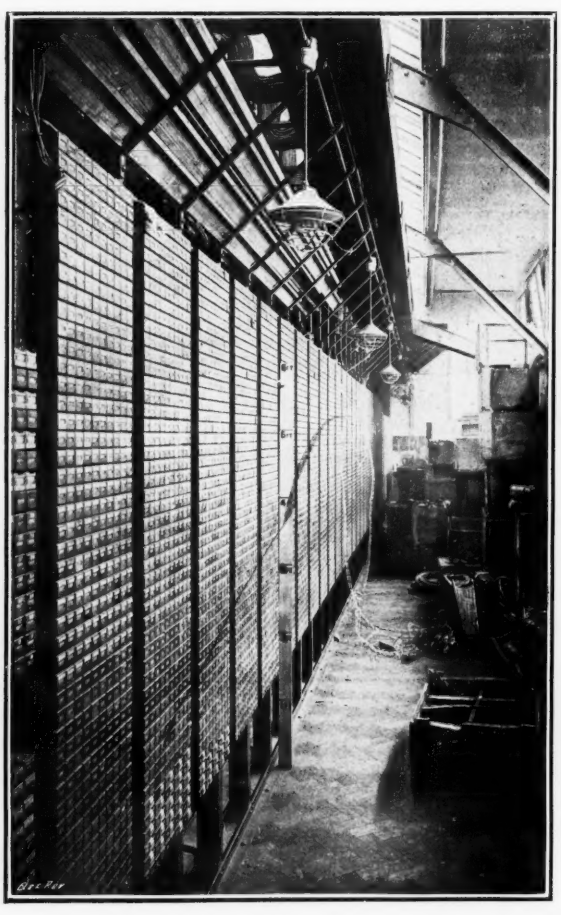


Fig. 19.—Meter Rack.

Meter Rack.—The meter rack is capable of accommodating 19,040 meters.

The intermediate distributing frame, relay and meter racks are shown in figs. 16, 17 and 19, and some idea of the mass of wires disposed upon the first-named will be gathered from fig. 18, which shows the frame at an early stage in its construction.

Immediately behind the meter rack is an iron cabinet with glass front, containing the lamp resistance frame, with a capacity for 18,180 lamps mounted in groups of 101.

Fig. 20.—Cabling on Top of the Relay and Meter Racks, and the Resistance Lamp Cabinet.

A rack against the east wall carries the condensers required for some of the outgoing junctions, and at the south end of the room, on the side opposite the entrance to the cable chute, is the main fuse cabinet. Here are disposed the fuses in the leads to the line relays, resistance lamps, meters, &c. As in the case of the repeating-coil fuse-boards, all the fuses are of the alarm type, and each bus-bar is provided with a tell-tale lamp to indicate the particular strip upon which a fuse has operated, whilst a bell common to all the bus-bars directs attention when necessary. Over 1,100 fuses are mounted on this board.

The cabinet is of mahogany-lined iron, with a glass door in front and an iron door behind.

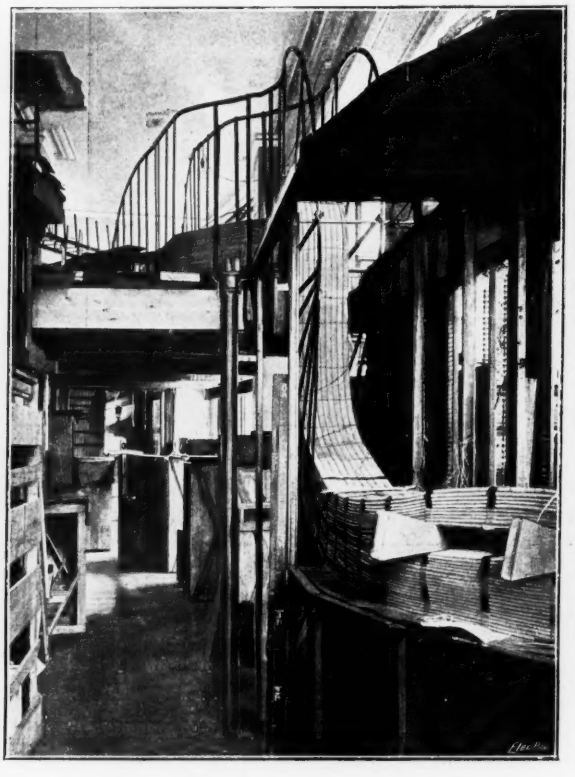


Fig. 21.—Cable run between the I.D.F. and the Switchboard.

Cable Runs.—Portions of the cable runs carrying the cables from the intermediate room to the switch room are shown in fig. 21, a reproduction of a photograph taken during construction, whilst a portion of the cabling between the relay and meter racks and the lamp resistance cabinet is shown in fig. 20.

Switch Room. — In one important respect the City Exchange marks a departure from previous English practice. Until recently a complete multiple of the subscribers' circuits upon all sections in an exchange was universally regarded as the best practice, but the requirements of areas with telephone users in great numbers and the obvious limitations of the number that can be multipled upon one board have brought about a modification.

Some attention has been given in Europe and America to the "divided multiple" system; but as this involves a retrograde step in subscribers' apparatus, inasmuch as it requires the selection of a push button and its being pressed as a preliminary to lifting the telephone receiver, it has found little favour.

A switchboard to take more than 20,000 subscribers has not been designed, and in an area in which circuits may be numbered by the hundred thousand, the percentage of connections which can be completed upon a board of even the dimensions named is not high.

In London at the present time not more than 20 per cent. of the calls originating at any one exchange can be completed without the assistance of an operator at some other exchange. In these circumstances, and in view of the great cost of a large multiple, the question has arisen whether it is sound policy to equip subscribers' sections with a multiple of the subscribers' lines; or whether it is preferable to treat all calls as junction calls, and so save the cost of the multiple. From a financial standpoint at least, the answer appears to be that, in the case of large exchanges, it is preferable to abolish the subscribers' multiple on the subscribers' sections, and to deal with the local traffic by means of transfer circuits, the connections being completed in every case at incoming junction positions equipped with complete multiples of the subscribers' circuits. It is necessary, of course, to retain the complete multiple upon the incoming junction boards, as practically all the calls there dealt with are for local subscribers.

One great advantage of the partial multiple is that it removes the limitation as to the size of an exchange imposed by the capacity of the multiple. For example, 60,000 subscribers could be connected to one exchange: their lines would be multipled at the junction boards by dividing them into four groups each of 15,000, each group being multipled separately. This arrangement would involve high numbers for subscribers, unless each group were numbered from 1 upwards, and distinguished by a letter or name.

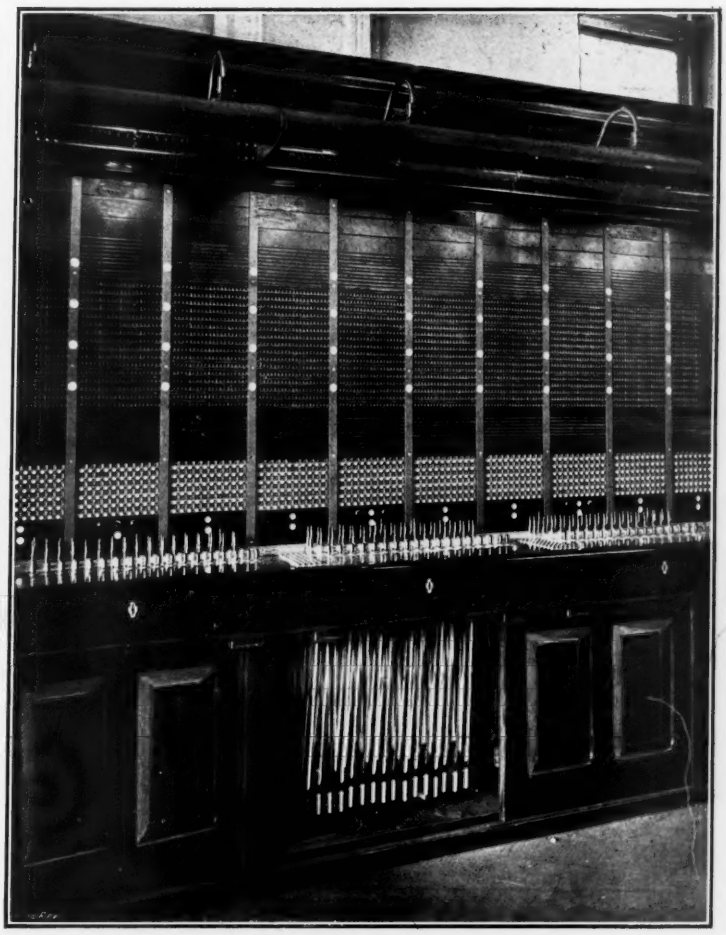


Fig. 22.—Subscribers' Switchboard. (Front View).

Fig. 23.—Subscribers' Switchboard, Rear View (During Construction).

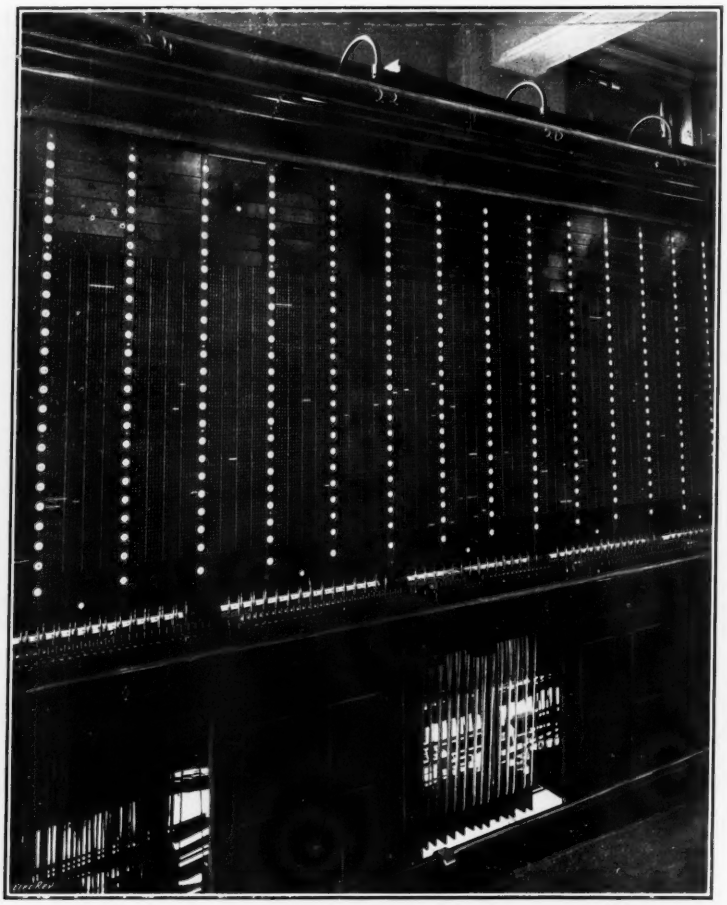


Fig. 24. Junction Switchboard (Front View).

The outstanding difference between the Central and City Exchanges lies in the application to the latter of the partial multiple principle. In the Central the subscribers' lines are multipled upon the subscribers' and junction boards alike: in the City they are multipled upon the junction board only. This difference explains the great disparity in the height of the switchboards on the two sides of the switch room, a feature which at once strikes a visitor to the City Exchange. In fig. 15 (a general view of the central portion of the switchroom), the subscribers' switchboard is on the left, and the junction board on the right: whilst in fig. 14, p. 179 (a plan of the second floor), the general arrangements of the switch room and intermediate room are shown.

A noteworthy point in connection with the City switchboards is their fireproof construction. Everything possible has been done to minimise fire hazards. The chamber containing the multiples is completely separated from the rest of the switchboard by a continuous partition of iron and uralite. As far as possible, power wires are isolated by being lead-sheathed: and, where this class of cable is unsuitable, they are carried in iron troughing. Wherever practicable, the switchboards themselves are constructed of iron, and the woodwork in front of the boards, as well as the doors behind, is lined with sheets of metal. Figs. 22 and 23, p. 181, are front and rear views respectively of the subscribers' switchboard; and figs. 24 and 25 are corresponding views of the Junction Board.

Relay and Resistance Spool Racks.—One other feature meriting attention is the provision of separate racks for the resistance spools and relays associated with the various cord circuits, pilot circuits, &c. In common battery exchanges it has hitherto been the practice—as, for example, in the Central—to mount these pieces of apparatus in the lower portion of the switchboards behind the cords — a position which manifestly renders difficult the tracing and dealing with faults during the busy periods of the day. By fitting the apparatus upon separate racks, the wiring and apparatus are readily accessible at all times. The racks occupy a position behind the switchboards, as shown in figs. 23 and 25. One rack is provided for, and stands immediately opposite, each section, short lengths of lead-covered cable connecting them.

Wiring of Circuits.—Although the various circuits at the City Exchange are identical in principle with those at other common battery exchanges in London, the wiring itself differs considerably, the difference being largely due to the removal of the relays, &c., from the switchboards, and to improved fuse provision. Formerly it was the practice to install separate fuses for the repeating coils and the supervisory lamps, the latter being grouped, and as each group was served thorough a single fuse, the blowing of a fuse affected a number of circuits.

Fig. 25.—Junction Switchboard (Rear View).

In the City exchange each cord circuit has a fuse through which is fed the current for both the signalling and speaking circuits. Thus, the blowing of a fuse affects one cord circuit only. This new method of wiring a cord circuit on the subscribers' answering board is shown in fig. 27.

Transfer Circuits.—The transfer circuits to be used for connections between the subscribers' and junction boards, and for connecting "City" to "Central" subscribers, and *vice versâ*, are operated in precisely the same manner as the junction circuits. They are multipled upon the subscribers' switchboard in the same way as are the outgoing junctions and along with them; whilst upon the junction board they are treated as incoming junctions.

Method of Answering a Call.—A brief sketch of the operating procedure involved when a subscriber desires a local connection may prove of interest. The lifting of a telephone receiver by a subscriber lights the lamp associated with his line and located upon the position upon the subscribers' board at which the line terminates. The operator thereupon inserts an "answering" peg into the subscriber's jack, pushes the lever of the speaking key on the cord circuit into the speaking position, and demands "Number, please?" The subscriber's requirement being, say, a local connection, the operator passes the number upon an outgoing call wire to an operator at the junction board, who names a disengaged transfer circuit, of which she picks up the peg; she makes a "test," and, if the circuit wanted be disengaged, inserts the peg in the jack, and presses the machine ringing key on the junction circuit. During this process the operator who handled the call at the outset completes the connection at the subscribers' board by inserting the calling peg of the pair into the jack of the junction named. This completes the operation until the clearing signal is displayed, when the operator at the subscribers' board first presses the meter key to record the call and then withdraws the pegs, passing a clearing signal automatically to the junction board, where the circuits are restored to normal.

A theoretical diagram showing a typical circuit outgoing at the Central Exchange and incoming at the City is given in fig. 26. It will be seen that unlike junction circuits ordinarily connecting two common battery exchanges, it has no repeating coil, a saving of this apparatus being effected and a diminution of efficiency avoided by the running of a third lead for signalling purposes.

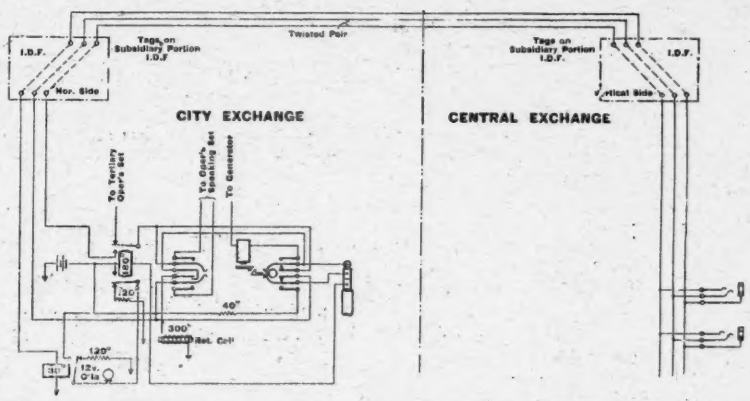


FIG. 26.—DIAGRAM OF TRANSFER CIRCUIT INCOMING AT CITY FROM CENTRAL EXCHANGE.

In the City Exchange there are a few other circuits which are new, but being of a minor character and intended for administrative purposes only, need not be described.

The work of equipping the City Exchange has been in progress during the past year, and as illustrating the magnitude of the task, it may be stated that the Exchange contains nearly half a million jacks, about 37,000 glow lamps, 42,000 relays, and over 7,000 miles of wire, while the number of soldered connections is over four millions.

The whole of the apparatus has been provided, and the work of installation carried out, by the Western Electric Co. Throughout its progress the work has been supervised by Post Office engineers, under Mr. J. H. Stanhope, the engineer-in-charge of the Central Exchange, whose duties will henceforward embrace the two Exchanges.

In all concerned there may well be engendered a feeling of pride that the City Exchange, in size and completeness, will be without its equal in the world.

We are indebted to Mr. Gavey, the Engineer-in-Chief of the Post Office, for placing at our disposal much of the information and many of the illustrations in this article.

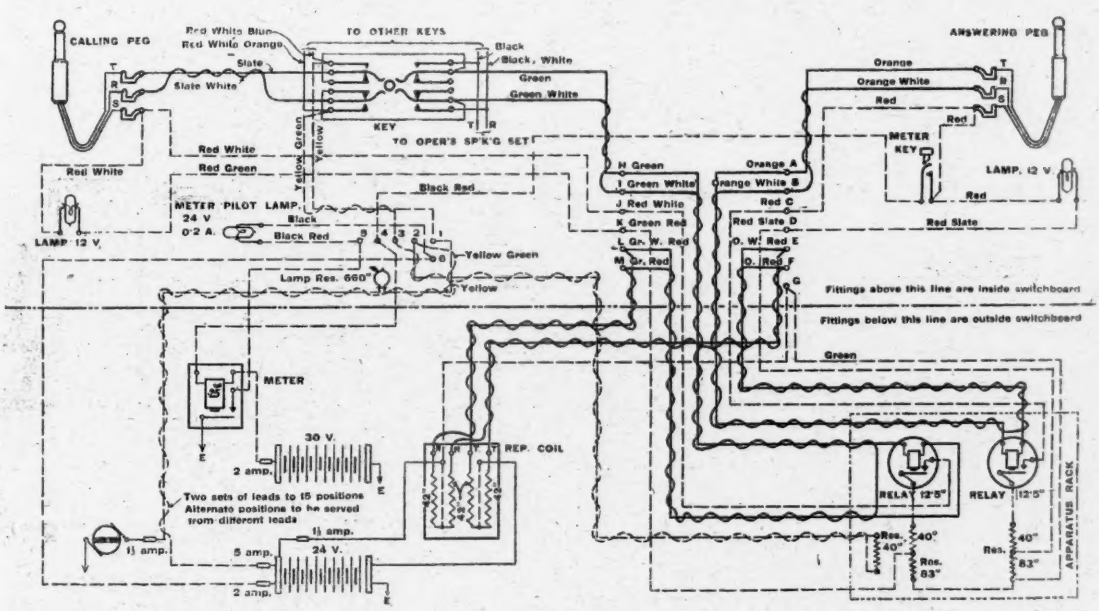


FIG. 27.—WIRING DIAGRAM OF SUBSCRIBER'S CORD CIRCUIT.

CONTRACTS CLOSED.

Aberdeen.—The Corporation has ordered six tramcar top-deck covers from the Brush Electrical Engineering Co., Ltd.

Cardiff.—The following is a list of the tenders submitted for telephones (central battery system), fire alarms and tell-tales, for Cardiff New Asylum :—

J. B. Saunders & Co., Westminster	(accepted)	£1,291 18
Gent & Co., Leicester		1,320 0
National Telephone Co.		1,329 17
Cox-Walkers, Darlington		1,454 0

Glasgow.—The Clyde Navigation Trustees have placed an order with Messrs. Pooley & Son, Glasgow, for four automatic weighbridges for use in connection with the electrically-operated coal hoists in the dock.

The Sub-Committee of the Tramways have accepted the following offers :—

India-rubber cable, Messrs. W. T. Glover & Co., Ltd.
Three-core lead-covered cable, the National Conduit & Cable Co., Ltd.
Single-core lead-covered cable, Messrs. W. T. Glover & Co., Ltd.

Leyton.—The U.D.C. on Tuesday opened the following tenders for tramway overhead electrical equipment, and referred them to the electrical engineer and Highways Committee with power to act :—

Dick, Kerr & Co.	£12,050	Brush Electrical Eng. Co. ..	£11,671
J. G. White & Co.	12,917	MacCartney, McElroy & Co.	14,069
R. W. Blackwell & Co. ..	12,094	British Electric Equipment Co.	11,404
„ Alternative tender	11,535		

The Council also received the following tenders :—

Two Dynamos.

T. Parker	£1,119	General Electric Co.	£1,405
Mather & Platt (accepted) ..	1,185	Brush Elecl. Engineering Co.	1,406
Greenwood & Batley	1,210	International Electrical Co.	1,480
Johnson & Phillips	1,216	Electric Construction Co. ..	1,502
Fowler & Co.	1,270	British Electric Plant Co. ..	1,530
Lancashire Dynamo Co. ..	1,281	British Thomson-Houston Co.	1,574
Siemens Bros. & Co.	1,330	Bruce, Peebles & Co... ..	1,630
Crompton & Co.	1,380	Electrical Co.	1,640
British Westinghouse Co. ..	1,390	Dick, Kerr & Co.	1,684
Vickers, Son & Maxim ..	1,393	Lahmeyer Electrical Co. ..	1,808

Overhead Crane.

Herbert Morris & Bastert (accepted)	£120	Dewsbury Electric Co. ..	£182
Carrick & Sons	169	Pickerings, Ltd.	217
Carrick & Ritchie	175	Holt & Willetts..	235
Spencer & Co.	180	Chatteris Engineering Co. ..	245
Larmuth & Co... ..	£180 and 230	Babcock & Wilcox	280

Roof Trusses and Angle Iron Purlins for Power Station Extensions.

Goddard, Massey & Warner (accepted)	£161	W. Bain & Co.	£182
A. J. Main & Co.	163	Needham & Lowe	183
Gilbert Thompson & Co...	176	Clyde Structural Iron Co. ..	194
		R. Morland & Sons	323

London.—Stepney.—The B.C. has received the following tenders in connection with the electric lighting undertaking :—

72 Boiler Tubes.

Stewarts & Lloyds, Ltd.		£108
British Mannesmann Tube Co., Ltd.	(plus cartage)	81
Babcock & Wilcox, Ltd.	(accepted)	81

50 Tons of Moulded Pitch.

		per ton
South Metropolitan Gas Co.	(accepted)	£1 19 6
Thomas Crow & Sons		2 0 0
Forbes, Abbott & Lennard, Ltd. ..		2 0 0

L.C.C.—The Stores Committee having considered tenders for the supply of electric lamps, proposes to accept the tender of Mackey's Electric Lamp Co., Ltd., at prices, subject to a discount of 2½ per cent., which are as follows :—Lamps for a voltage of from 100 to 150 volts and of 5, 8 and 16 c.p., 5¼d. each, 32 c.p., 6¼d. each ; lamps for a pressure of 150 to 250 volts and of 8 and 16 c.p., 6¾d. each, 32 c.p., 7¾d each, and 50 c.p., 1s. 6d. each. Frosted bulbs are to be 9d. extra per dozen.

The following tenders have been received by the L.C.C. for the execution of the roadwork and platelaying in connection with the construction of tramways from Camberwell Green to Lordship Lane, the length being about 4½ miles of single track, and the contract also including certain paving works :—

Robert W. Blackwell & Co. ..	(recommended)	£82,620 11 11
A. Krauss & Son		84,078 7 0
John Mowlem & Co.		86,548 0 0
Dick, Kerr & Co.		89,663 3 3
Muirhead, Greig & Matthews		89,992 10 10
J. G. White & Co.		92,460 2 4
William Griffiths & Co.		92,894 14 5

Engineer's estimate of the cost, £88,109 6s. 11d.

Marylebone.—The B.C. has received the following tenders for levelling the site adjoining the generating station, which is to be used as a store-yard :—

John Mowlem & Co.		£2.310
Allen Fairhead & Son		2,153
John Grover & Son		2,139
Henry Lovatt, Ltd.		2,090
F. & H. F. Higgs		2,097
F. G. Minter	(accepted)	1,981

Marylebone.—The B.C. has accepted the following tenders for stores for the electricity department for the 12 months ending March 31st, 1907 :—

G. Johnston & Co., oils, gauge glasses, packing, &c.
R. H. Vincent, oils, candles, soap, enamel, &c.
Wilcox & Co., rags, axes, brooms, brushes, soldering irons, &c.
Croager Bros., tape, rope, &c.
Geo. Hatch, ironmongery.
F. Bird & Co., ditto.
C. F. Chesterman, timber.
W. McGeoch, Ltd., ditto.
Edison & Swan, installation fittings.
Lucy & Co., service boxes.
H. Sabey & Co., cement and bricks.
Charrington, Sells, Dale, Ltd., coke.
Krupka & Jacoby, carbon brushes, &c.
Pryke & Palmer, iron and lead piping.
G. Schultz & Co., mica.
Piggott Bros. & Co., jointers' tents.
Stephen Carter, jointers' trucks.
Siemens Bros., cable trolleys.
J. Smith & Co., tarpaulins.

In all 103 tenders were sent in.

Islington.—The B.C. has accepted the tender, at £255, of the British Thomson-Houston Co. for six electric motors at the Caledonian Road baths.

Newcastle (N.S.W.).—The City Council has accepted the tender of Messrs. Noyes Bros. for additions to the electric lighting plant, at £2,585.

Staffordshire.—The C.C. has accepted the tender of the Walsall Electrical Co., Ltd., for the installation of the electric light at the new schools at Darlaston, at £125 10s.

FORTHCOMING EVENTS.

To-day's Events (Friday, February 2nd).—At 9 p.m. Royal Institution. Prof. S. P. Thompson on "The Electric Production of Nitrates from the Atmosphere."

At 8 p.m. Junior Institution of Engineers. At Westminster Palace Hotel. Mr. K. Edgcumbe on "Some Recent Electrical Engineering Measuring Instruments."

At 5.45 p.m. Northampton Institute Engineering Society. Mr. E. V. Pannell on "Electric Traction Controllers and Control Systems."

Saturday, February 3rd.—At 10 a.m. I.E.E. (Students). Visit to the G.W.R. Electric Lighting Installation at Paddington.

At 3 p.m. City of London College Science Society. Visit to the Signal Box at Charing Cross Station.

Monday, February 5th.—At 7.30 p.m. Society of Engineers. Inaugural address by Mr. M. Wilson.

At 8 p.m. I.E.E. (Newcastle). Mr. R. E. Robson on "The Electric Wiring of Small Buildings in course of Erection." Mr. F. Little on "Electric Ignition of Motor-Cars."

At 8 p.m. Society of Arts. Cantor Lecture by Sir Wm. White on "Modern Warships" (Lecture II.)

Wednesday, February 7th.—At 8 p.m. Society of Arts. Mr. Leon Gaster on "Progress in Electric Lighting."

Thursday, February 8th.—At 8 p.m. I.E.E. Conclusion of Discussion on Mr. F. W. Carter's paper on "Technical Considerations in Electric Railway Working." Mr. C. W. Hill on "Crane Motors and Controllers."

Friday, February 9th.—At 7.30 p.m. I.E.E. (Manchester Students). Mr. H. A. Carney on "Electrical Instruments."

At 8 p.m. Physical Society. Annual general meeting. Address by the President-Elect, Prof. J. Perry.

At 8 p.m. I.C.E. (Students). Mr. R. H. Mackie on "Electric Driving at the Locomotive Works of the N. L. Railway."

Saturday, February 10th.—Junior Institution of Engineers. Anniversary dinner at the Hotel Cecil.

At 7.30 p.m. Electrical Trades Union (London). Concert and dance at Battersea Town Hall.

I.E.E. Students' visit to G.P.O. Telephone Exchange postponed to March 3rd.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued :—

Monday, February 5th.—"A" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Tuesday, February 6th.—"B" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m. ; medical examination recruits, 7 p.m.

Wednesday, February 7th.—"A" badge examination for "A" and "B" Companies.

Thursday, February 8th.—"C" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Friday, February 9th.—"D" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Saturday, February 10th.—Week-end instruction for country members of "C" Company.

J. Gunn, Sergeant-Major.
For O.C.E.E.R.E. (V.).

NOTES.

The Testing of Rubber Insulated Wire.—As there appears to be so much uncertainty as the qualities of wires at present on the market, the proposals of the National Board of Fire Underwriters of America to devise ways and means for testing all rubber-covered cables, so as to prevent the introduction into commercial use of any wire which does not come up to the standard demanded by the National Board, merit attention. It is proposed that a committee, called the Wire Inspection Bureau, be formed, consisting of about six members. This committee would draw up specifications for testing rubber-insulated wire, and would also appoint the necessary electrical inspectors, who would visit the testing rooms of the various manufacturers in order to verify the tests specified by the Bureau. Identification stamps would be supplied to show that these had passed the specified test, and it is proposed to raise the necessary expenses by issuing stamps and selling these to the different manufacturers at a charge of 1 cent per 100 ft. of wire tested. These stamps would then be attached to the coils by the manufacturers themselves, and would serve as a kind of guarantee that the wire or cable was of good quality and up to the "standard."

The New Parliament.—Mr. Arnold Lupton, the new member for the Sleaford Division of Lincolnshire, is a member of the Institution of Electrical Engineers and also M.I.C.E. He has been associated with several large electrical enterprises. The original electrical power scheme of 1898, with an area of supply defined by a radius of 20 miles round Chesterfield, was due very largely to Mr. Arnold Lupton's initiative, the engineering being in his hands throughout, but his efforts on that occasion proved fruitless, as all will remember the antagonism shown to the proposal, and its rejection by Parliament. In 1901 Mr. Lupton acted as joint engineer to the Yorkshire Electric Power undertaking, and for a similar scheme affecting Leicester and Warwick. Mr. Lupton is joint author of a work on "Electricity as Employed in Mining Operations." As a civil engineer he has carried through and managed some extensive mining work.

Mr. Robert Armitage, who defeated Mr. Gérald Balfour at Leeds, is a director of the Yorkshire Electric Power Co. and also of the Power Gas Corporation; apart from these undertakings, to which he devotes valuable attention, he is an influential Yorkshire ironmaster.

Technical Education.—Battersea Polytechnic.—Mr. Frank Broadbent, M.I.E.E., has undertaken, at the request of the authorities, to conduct the evening classes in electrical engineering at the Battersea Polytechnic for the remainder of this session, Mr. R. G. Cooke, the former head of the department, having been appointed to the principalship of the Paddington Technical Institute.

Municipal Finance.—The Municipal Trading Committee of the London Chamber of Commerce, on Friday last, held a special meeting to consider the recent appointment of a Departmental Committee by the L.G.B. to deal with municipal accounts. The Committee unanimously resolved that having regard to the unanimous recommendations of the Joint Committee on Municipal Trading, 1903, the Departmental Committee, consisting principally of Government and municipal officials, did not conform to the recommendations of the Joint Committee, and that its decisions could not command the confidence of the commercial community. Arrangements are being made for a conference of Chambers of Commerce, Municipal Corporations, &c., to discuss the independent professional audit and standardisation of municipal accounts.

The Kent Collieries Power Scheme.—At an extraordinary general meeting of Kent Collieries, Ltd., a resolution was passed by an overwhelming majority (on a poll) approving the Bill which is to be introduced into Parliament with the object of empowering the company to supply electrical energy to the S.E. and Chatham Railways, carry mains along them, and supply electricity to any consumer whom they might be able to reach from the railways.

The "Waggot" Surface Contact System.—This system differs in one respect only from those practical systems with which our readers are acquainted, and it is in that respect that we consider it most likely to fail. The claims made for it in the pamphlet published for the owners are concerned largely with points which are claimed legitimately by any surface contact system, and the only one which need occupy us is that which seeks to reduce the bulk of, and loss of energy in, the magnets used on the car.

The switch in the front stud having been "picked up" by the leading electro-magnet, it is kept up by a permanent magnet which, by itself, was unable to exert the initial tractive effort. The trailing electro-magnet (for there are but two), by reason of its greater power in the opposite sense, overcomes the pull of the permanent magnet exercised through its soft iron polar extensions, and demagnetises the armature of the switch, which thereupon breaks contact.

Setting aside the detailed design of the contact box, which seems to require modification to fit it for use in the streets, it remains to be proved that any system of permanent magnets will perform the exacting and continuous duty which is required in this service. One of the chief safeguards of the ordinary multi-magnet skate of the other systems lies in the fact that when the magnet circuit is broken accidentally, all switches fall out of contact and studs cannot remain alive, but it is easy to conceive circumstances which are indeed of daily occurrence on most tramways, under which the trailing magnet would not throw down the trailing switch, and the permanent magnet would keep the stud alive until the next car passed.

The effort of Mr. Waggot to reduce the bulk of the collecting apparatus of an electro-magnetic system of surface contacts is laudable, and helps to show how objectionable that feature is, but we must withhold our congratulations on an accomplished fact until the system has proved itself on a larger and more life-like scale than that on which it is being exhibited at the Builders' Exchange in Birmingham.

Thermit Welding in America.—In a paper read before the Franklin Institute, and reproduced in the *Journal* for December last, Mr. E. Stütz describes the uses to which thermit has been successfully applied in the U.S.A. We note that 30 cities there have tried the process up to the present, and some 13,000 joints in tramway rails have been made. In Cleveland, Ohio, 3,000 joints were put in, after a sample lot had survived the winter, and in Holyoke, Mass., about 1,000 have been made after a similar trial. In both cases the street railway company does all the work with its own staff, only buying the materials and crucibles from the Golschmidt Thermit Co. In one day a gang of four men will make 30 joints. Joints have been made on track traversed by cars at 10-minute intervals, without interrupting the traffic. As a rule the head of the rail does not need grinding, the slag which covers it being knocked off easily, and the head is not softened. Between 300 and 400 joints have been made in Grand Street, New York.

The principle guiding the construction of the mould is that the molten steel must not inpinge upon the parts to be welded, but must run through the gate to a point below the lowest part, and rise round the joint or fracture. To ensure a sound weld, the quantity of thermit used should be double that required to fill the actual collar which surrounds the joint. The moulds, if made of sand and clay, must not merely be dried, but burnt dry. A variety of interesting welding feats is described.

"After-Dinner Speeches."—The following letter from "X" is the one referred to on p. 167 of our "Correspondence" columns:—

"I notice from your report of the speeches made at the dinner of the General Electric Co. that Mr. Hirst, in referring to the many changes that had taken place in his company's staff, implied that they were rendered necessary by incompetence, or neglect of duties, on the part of those who, for one reason or another, had left it during the past year.

"Had Mr. Hirst troubled to think, he would have realised that he was committing an act of grave injustice in levelling a general accusation against a number of men well-known and esteemed in their profession, in such a manner as to render it impossible for them to defend themselves.

"I do not wish to exaggerate the importance of an after-dinner speech: but there is no doubt that what was said was seriously meant, as such subjects are not introduced on an occasion of this kind without some deliberate intention. In addition, the remarks have been reported in the Press, so that they should not be allowed to pass without a protest.

"Mr. Hirst forgets that the public knows little, and cares less, about the internal affairs of his company and its relations with its employés; so that, on bearing his remarks, it includes in their scope all who have left at all recently. In this manner Mr. Hirst's insinuations concern not only those who may have been discharged, but also those who have resigned for reasons of their own, while possessing the full confidence of their directors; and that this is the position of affairs in several cases I have direct personal knowledge.

"It is to be hoped that Mr. Hirst, when he realises the injustice done to those who, whatever his opinion of them may be now, have served him well for many years, will see his way to withdraw his remarks and to apologise."

Improving Trade. — At the annual meeting of the Leeds Chamber of Commerce on Tuesday the President congratulated the members upon the cheering character of the yearly report, which pointed to a general improvement of trade throughout the country, especially in the cloth, shipbuilding, engineering, iron, steel, cotton, leather, machinery, and mill work. There was also an all-round improvement in the foreign trade, which, as the council pointed out in their report, emphasised the great need for impartial and careful inquiry before any changes were made in the fiscal policy of the country.—*Daily Telegraph.*

The Electrical Industry Meets at the "Blue-Eyed Maid."—The "Operative Society of Electrical Workers of Great Britain" (comprehensive title!) held a "select" smoking concert on January 27th. This Society, we learn from the programme, was established in December, 1902, and the concert was organised "for the purpose of bringing together *all those engaged in the electrical industry*" (who smiled?) for a social gathering. We are informed that the concert—which, be it known, was held at the "Blue-Eyed Maid," High Street, Borough, which is the Society's club house—was a very successful one, and that some of the oldest workers in the electrical industry met and spent a very enjoyable evening. We know *some* who were not present. We do *not* learn that the President of the I.E.E. was in the chair, nor that the members of the Manufacturers' Association were to the fore; however, if any old hands want to know more about this Society, they should write to Mr. H. K. Barnes, the secretary, at the address of the aforesaid "Blue-Eyed Maid."

Appointments Vacant. — Resident station superintendent for the North Wales Power and Traction Co., Ltd. (£200); junior assistants for the Newcastle-upon-Tyne Electric Supply Co., Ltd.; a canvasser for the Aston Manor electricity department; armature winder for Gloucester Light Railways department.

Fatality.—It is reported that a man employed by Messrs. Seymour Mead, Ltd., Southport, was attending to a dynamo on Wednesday, when the belt caught his coat sleeve and dragged his right arm into the pulley, almost severing it from the body. The man died soon after being admitted to the Infirmary.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—The Gloucester T.C., on January 24th, adopted the Committee's recommendation, and appointed Mr. GEO. R. WHITE, the present assistant engineer, as chief electrical engineer, at a salary of £250 per annum, increasing £25 per annum for two years.

Mr. J. E. MALLALIEU, of Messrs. Dick, Kerr & Co., Ltd., has recently been appointed power station engineer for the Burma Electric Tramways and Lighting Co., Mandalay, and sails from Liverpool on February 8th, by ss. *Tenasserim.*

Last week the staff at the Heston and Isleworth Electricity Works made a presentation to Mr. J. ARTHUR SYKES, the chief assistant engineer, on the occasion of his marriage. Mr. F. A. Bond, the electrical engineer, on behalf of the staff, presented him with a handsome black marble clock. A gold brooch, also the gift of the staff, was sent to Mrs. Sykes.

MR. CHARLES ASTBURY has been appointed resident electrical engineer to the Atherton U.D.C., as advertised some time ago in our pages. There were 130 applications for the post. Mr. Astbury was previously with the Dudley Corporation Electricity Works.

Mr. R. GOLDING, of Blackburn, has been appointed an assistant at the Ealing Corporation Electricity Works.

Mr. A. T. CROSHER has been appointed borough electrical engineer at Te Aroha, N.Z.

Tramway Officials.—The Gloucester T.C. has appointed Mr. STEPHENS as traffic superintendent of the tramways.

General.—Mr. MCFEE, the general manager of the Glasgow Corporation Telephone Department, has been granted leave of absence for one month on account of the unsatisfactory state of his health.

The *Times* says that Major F. BAYLAY, R.E., Instructor in Electricity at the School of Military Engineering, Chatham, has, on the completion of his period of appointment, been ordered to proceed on a tour of duty in India.

At Gateshead, on Friday last, the officials, staff and workmen of Messrs. Ernest Scott & Mountain, Ltd., held a successful smoking concert. The object of the gathering was to make a presentation to Mr. ARTHUR E. HOPPER, assistant works manager, who is leaving the firm to take up a similar position in Sheffield at the works of Messrs. Cammell, Laird & Co., Ltd. The chair was occupied by Mr. W. C. Mountain, managing director, and Mr. W. F. Coaker was in the vice-chair. In the course of the evening Mr. Geo. Johnson presented Mr. Hopper with a handsome lounge chair on behalf of the workmen. On behalf of the officials and staff, Mr. Mountain then asked Mr. Hopper to accept a smoking cabinet. He said he could look back to the time when Mr. Hopper came as a pupil (about 12 years ago), and asked his (Mr. Mountain's) advice regarding the electrical trade. He said it was not much of a business then, but he thought there was a good prospect for the future. Mr. Hopper was a young man then, and accepted what Mr. Mountain told him. He came and served his time, and he could hardly say how well he had carried out his duties. At one time, in the old works at Newcastle, Mr. Hopper had been manager of the electrical department, and, when they removed to Gateshead, Mr. Hopper took charge of the removal and erecting of the new shops, &c., and they all knew how well that work had been carried out. Mr. Hopper now had the qualifications of a civil engineer, an electrical engineer, and a builder of works, and he was going to assist in the management of one of the largest steel works in Sheffield. Mr. Hopper, in his reply, said he really could not find words to express his thanks for the very kind words which Mr. Johnson and Mr. Mountain had said about him. He felt that in leaving the firm after a 12 years' service was like leaving home. He said he could never have better masters to serve than the firm of Ernest Scott & Mountain, Ltd., and he hoped those he left behind would co-operate and help forward the work which was in hand at the new works.

Obituary.—The death occurred on January 26th of Mr. JOHN LOCKIE, at the early age of 43 years. In his earlier years he had been engaged in engineering and shipping work on the Tyne, which efforts were attended by a certain measure of success. As his doings in recent years have been the subject of investigations both in Bankruptcy Court and before magistrates, we have no need to rehash what is already more or less familiar matter respecting the charges brought against him connected with his dealings with his several companies. His chief claim to mention in our pages lies in his efforts of some four or five years ago to form what was called the National Industrial Association, a movement described at the time as "a great and patriotic endeavour to create and cement a feeling of common interest between employer and employé." Another object was to inquire into and report upon matters affecting British trade and commerce, while yet another was to create permanent machinery for settling trade disputes. In 1902, by his financial support, certain Trades Commissioners were dispatched to South Africa to report on the position of markets there, and the prospects of British industry. These reports were undoubtedly of valuable assistance to our manufacturers at a time when, the war having ended, they were just looking for awakening trade in that part of the world. The reports are still in circulation, but whether the National Industrial Association is now in existence we are not prepared to say. It was Mr. Lockie's intention to support it until it became self-supporting, but Mr. Lockie himself came to grief shortly after his election to Parliament in 1902, and it is improbable that the Association was by that time on its own legs. Those who have any interest in the matter, will find an exhaustive and critical examination into the proposals of the founders of the Association in the ELECTRICAL REVIEW of October 4th, 1901, pp. 542-3. We should, in fairness to Mr. Lockie, say that no verdict was given regarding the charges against him, as he had a paralytic seizure during the trial, and from that he never recovered.

By the death of M. DESPECHER, who passed away on 29th ult., at the age of 83 years, submarine telegraphy has lost another of its pioneers. For more than half a century, says the Paris correspondent of the *Tribune*, he has been the organiser of all submarine cable enterprises created between the French Government and the English companies before France possessed factories capable of constructing cables and laying them. With Sir John Pender, Mr. Cyrus W. Field, and Sir George Elliot, he organised the first cable between Europe and America. M. Despecher was, in 1861, one of the promoters of the cable between France and Corsica.

NEW COMPANIES REGISTERED.

Hunslet Electrical Pottery Co., Ltd. (87,353).—This company was registered on January 24th, with a capital of £3,000 in £1 shares, to carry on the business of manufacturers of and dealers in earthenware and pottery, in connection with electrical fittings of all kinds. The first subscribers (each with one share) are:—T. D. Ibbitson, 100, Cardigan Road, Leeds, manufacturer; W. A. Ibbitson, Holbeck Mills, Leeds, manufacturer; J. Hepworth, junior, 19, Park Drive, Harrogate, solicitor; A. D. Brighouse, 20, Springfield Place, Leeds, solicitor; H. W. Ibbitson, 100, Cardigan Road, Leeds, manufacturer; E. D. Ibbitson, 100, Cardigan Road, Leeds, manufacturer; and H. Newbound, 20, Queen Square, Leeds, clerk. No initial public issue. The number of directors is not to be less than three nor more than five; the first are W. A. Ibbitson, J. Hepworth, junior, A. D. Brighouse and E. D. Ibbitson; qualification, £100: remuneration, £15 per annum, divisible. Registered office, Balm Road Mills, Hunslet, Leeds.

Curative Electricity Co. (87,347). — This company was registered on January 24th, as an unlimited company, with a capital of £100 in £1 shares, to manufacture and sell an appliance known as the "Curative Electricity Coil," &c. The first subscribers (each with one share) are:—R. Pittman, 6, Guildhall Chambers, E.C., chartered accountant; C. Pittman, St. Osyth, Sidcup, chartered accountant; B. Bowles, 5, Mafeking Avenue, Seven Kings, Essex, incorporated accountant; H. G. Davies, Trelawne, Coniston Road, Muswell Hill, N., articled clerk; Mrs. A. Pittman, St. Osyth, Sidcup; Mrs. E. Skeet, St. Osyth, Sidcup; and W. Pittman, St. Osyth, Sidcup, accountant. No initial public issue. Table "A" mainly applies. The first directors are R. Pittman and C. Pittman. Registered office, 6, Guildhall Chambers, E.C.

Hankon Light and Power Co., Ltd. (87,331).—This company was registered on January 27th, with a capital of £20,100 in 2,000 ordinary shares of £10 each, and 2,000 deferred shares of 1s. each, to carry on the business of electrical, mechanical and chemical engineers, contractors, electricians, suppliers of electricity, producers and suppliers of light, heat, sound and power by electricity, galvanism, magnetism or otherwise, &c. The first subscribers (each with one deferred share) are:—G. G. Tucker, Wetherden, Warwicks Bench, Guildford, gentleman; R. Irwin, 3, St. Lawrence Road, Brixton, S.W., salesman; F. G. Randall, 6, Thorpe Road, Forest Gate, warehouseman; A. J. Holdstock, 1, Codrington Villas, Codrington Hill, Brockley Rise, S.E., engineer; A. T. Colley, 32, Trewsbury Road, Sydenham, S.E., merchant; S. W. Hart, 11, Seymour Villas, Anerley, S.E., accountant: and H. G. M. Rickcord, 2, Peterborough Road, Harrow, clerk. No initial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £100; remuneration £150 per annum, divisible. Registered office, 23, College Hill, E.C.

Commercial Electro-Chemical Analysis Co., Ltd. (87,306).—This company was registered on January 22nd, with a capital of £2,000 in £1 shares, to take over the business of an electro-chemical analyst carried on at 8, St. Ann's Road, Wandsworth, by E. B. Vaughan, with the journal called the *Electric Accumulator*, published by him, and the laboratory and other property appertaining to the said business. The first subscribers (each with one share) are:—E. B. Vaughan, 8, St. Ann's Road, Wandsworth, S.W., electrical engineer; A. B. Vaughan, 8, St. Ann's Road, Wandsworth, S.W.; C. A. Farley, 45, Spencer Park, Wandsworth, yeast merchant; Mrs. K. A. Farley, 45, Spencer Park, Wandsworth, S.W.; A. S. Tanner, 41, Sydney Street, South Kensington, S.W., architect; R. W. Vicarey, Black Hill, Clun, Salop, electrical engineer; and Mrs. D. Vicarey, Clun, Salop. No initial public issue. Registered without articles of association.

Medical-Electro Vibration Institute, Ltd. (87,372).—This company was registered on January 25th, with a capital of £1,000 in £1 shares, to administer treatment by means of static electricity, high frequency faradic currents, galvanic currents, radiant heat baths, X-rays, mechanical and electrical vibration, &c., and to carry on the general business of medical electricians at Bradford, or elsewhere. The first subscribers (each with one share) are:—J. D. Mander, 4, Chesham Grove, Bradford, cashier; C. R. Porter, 4, Spring Bank, Bradford, medical electrician; W. Durrance, 7-8, Exchange Buildings, Bradford, solicitor; H. B. Ratcliffe, 7-8, Exchange Buildings, Bradford, solicitor; W. Harrison, Nab Wood, Shipley, wood merchant; J. C. Whitaker, 44, Arncliffe Terrace, Bradford, cashier; and F. Morgan, 85, Arncliffe Terrace, Bradford, clerk. No initial public issue. The number of directors is not to be less than two nor more than three; the first are C. R. Porter (managing director) and W. Harrison; qualification, £50. Registered office, 4, Spring Bank, Bradford.

Ilford Accumulators, Ltd. (87,316).—This company was registered on January 22nd, with a capital of £12,500 in 11,500 preference shares of £1 each and 30,000 founders' shares of 1s. each, to adopt an agreement with the Negociators and Development Syndicate, Ltd., and to carry on the business of manufacturers of electrical apparatus, scientific instruments, petrol, steam and electric motors, motor-cars and cycles, dynamos, storage and primary batteries for submarine and torpedo boats, accumulators for central station lighting and public buildings, &c. The first subscribers (each with one preference share) are:—C. E. Sellen, 55, Storks Road, S.E., traveller; J. E. Brand, 97, Edith Road, West Kensington, clerk; E. S. W. Thorp, Belmont, Staines, manufacturer of electrical appliances; E. A. Kemp, 58, Seymour Gardens, Cranbrook Park, Ilford, manufacturer of electrical appliances; E. Tiquet, 206, London Road, Romford, electrical engineer; J. Taylor, 79, Cranfield Road, Brockley, gentleman; and F. S. Rising, Effingham House, Arundel Street, W.C., late Lieut. R.N. No initial public issue. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification (except first directors) £250 shares or stock; remuneration £100 each per annum (chairman £50 extra) and 5 per cent. of the profits available for dividend in excess of 7 per cent., divisible. Registered office, 24, Borough High Street, S.E.

Headingley Motor and Engineering Co., Ltd. (87,390).—This company was registered on January 26th, with a capital of £1,000 in £1 shares, to acquire the business of engineers, electricians, electrical engineers, suppliers of electricity for light, heat, motive power and other purposes, manufacturers of and dealers in motors, cycles and vehicles, &c. The first subscribers (each with one share) are:—J. S. Savile, 12, Otley Road, Headingley, printer and stationer; Mrs. E. Savile, 12, Otley Road, Headingley; R. A. Savile, Scarborough Road, Otley, butcher; J. J. Nicholson, 14, St. Michael's Lane, Headingley, cabinet maker; Mrs. S. Nicholson, 14, St. Michael's Lane, Headingley; G. Bard, 24, Leicester Place, Leeds, cabinet maker; and W. H. Clarke, 12, South Parade, Leeds, solicitor. No initial public issue. The first directors are J. J. Nicholson and J. S. Savile (qualification 100 shares). Registered office, 18, St. Michael's Lane, Headingley, Leeds.

Madras Electric Supply Corporation, Ltd. (87,409).—This company was registered on January 27th, with a capital of £400,000 in £5 shares, to carry on in India or elsewhere the business of an electric light and power company, and that of electrical engineers, electricians, engineers, contractors, manufacturers of and dealers in cables, wires, lines, accumulators, lamps and electrical appliances, &c., and to acquire concessions or licences granted by and enter into contracts with the Indian Government or other authority. The first subscribers (each with one share) are:—A. M. H. Walrond, 17, Rutland Court, Knightsbridge, S.W., gentleman; Sir W. J. Cuningham, Queen Anne's Mansions, S.W.; T. E. Ivens, 18, King's Avenue, Ealing, W., A.M.I.C.E.; Sir Ralph D. R. Moor, 23, Carlisle Mansions, Victoria, S.W.; J. G. B. Stone, 1, Sloane Terrace Mansions, Sloane Square, S.W., stockbroker; F. R. Reeves, Lynwood, Totteridge, Herts, engineer; and F. Medcalf, 9, Great St. Helens, E.C., solicitor. Minimum cash subscription, 500 shares. The number of directors is not to be less than three nor more than seven; the first are A. M. H. Walrond, Sir Wm. J. Cuningham, K.C.S.I., T. E. Ivens, Sir Ralph D. R. Moor and J. G. B. Stone; qualification, £1,000; remuneration, £400 per annum for the chairman, and £250 each for the others, with 6 per cent. of the surplus profits remaining after 7 per cent. is paid to the shareholders, divisible. Registered office, Salisbury House, London Wall, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

G. and A. J. Cross, Ltd., electrical engineers, &c., Tunbridge Wells (86,950).—£600 5 per cent. debentures, created and dated January 9th, 1906, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. Holders: G. Cross, 14, High Street, Tunbridge Wells, and A. J. Cross, of same address. No trustees.

Engineering Instruments, Ltd. (recently known as "Schattner Electricity Meter Co., Ltd.") (66,472).—The company's annual return was filed on January 5th, when 15,000 ordinary and 12,500 deferred shares had been taken up out of a nominal capital of £50,000 in 37,500 ordinary and 12,500 deferred shares of £1 each; £15,000 has been paid on the ordinary and £12,500 is considered as paid on the deferred. Mortgages and charges: £2,000.

Drake & Gorham, Ltd. (70,275).—This company's annual return was filed on December 1st, when the entire capital of £125,000 in £1 shares had been taken up; £1 per share has been called up and paid on 85,000, and 40,000 are considered as fully paid. Mortgages and charges: Nil.

Provincial Tramways Co., Ltd. (6,445).—This company's annual return was filed on December 30th, when 10,000 preference and 24,912 ordinary shares had been taken up out of a nominal capital of £400,000 in 10,000 preference and 30,000 ordinary shares of £10 each. £287,260 has been received, and £61,860 is considered as paid. Mortgages and charges: £53,000.

British Thomson-Houston Co., Ltd. (47,982).—This company's annual return was filed on November 24th, when the entire capital of £800,000 in 40,000 ordinary and 40,000 4 per cent. cumulative preference shares of £10 each had been taken up; £10 per share has been called up on 32,531 ordinary, and 40,000 preference and £725,310 has been received. £74,690 is considered as paid on 7,469 ordinary. Mortgages and charges: £212,000.

Arc Lamps, Ltd. (70,795).—This company's annual return was filed on January 13th, when 55,300 shares had been taken up out of a nominal capital of £60,000 in £1 shares. £1 per share has been called up on 7,300, resulting in the receipt of £7,250. £50 remains in arrears. 48,000 shares are considered as fully paid. Mortgages and charges: Nil.

Aberdare Electric Lighting Co., Ltd. (67,037).—This company's annual return was filed on December 30th, when 340 shares had been taken up out of a nominal capital of £2,000 in £1 shares. No calls have been made. Mortgages and charges: Nil.

British Tramways and General Construction Co., Ltd. (78,034).—This company's annual return was filed on December 29th, when 241,000 shares had been taken up and paid for in full out of a nominal capital of £300,000 in £1 shares. Mortgages and charges: Nil.

Walsall Electrical Co., Ltd. (37,696).—This company's annual return was filed on January 13th, when 12,000 ordinary and 4,380 preference shares had been taken up out of a nominal capital of £25,000 in £1 shares (subdivision not stated); £1 per share has been called up on 10,000 ordinary and 4,380 preference, resulting in the receipt of £14,380; 2,000 ordinary are considered as fully paid. Mortgages and charges: £3,000.

Uxbridge and District Electric Supply Co., Ltd. (62,706).—Issue on January 9th of £400 5 per cent. debentures, part of series created July 14th, 1904, to secure £35,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £33,000.

Frinton-on-Sea and District Electric Light and Power Co., Ltd. (70,689).—Issue on December 29th of £1,100 debentures, part of series created October 26th, 1905, to secure £3,000 and 5 per cent. interest, charged on the company's undertaking and property, present and future, including uncalled capital, subject to £3,000 first mortgage debentures. Holders: W. Webster and Miss A. A. Mackay, 50, Lee Park, Blackheath. No trustees. No previous issue of same series.

Private Wire and Telephone Installation Co., Ltd., London (76,988).—A memorandum of satisfaction in full of debentures dated April 27th, 1903, securing £2,000, has been filed.

Veritys, Ltd. (Electricians, London, Manchester and Birmingham) (49,784).—£40,000 6 per cent. debentures, created and dated January 9th, 1906, have been registered. Property charged: The company's undertaking and assets, present and future. No trustees.

Perth Electric Tramways, Ltd. (55,935).—Issue on January 3rd of £6,000, part of series created December 22nd, 1903, to secure £50,000, charged on the benefit of certain agreements, deposit, provisional order and Acts of Parliament, tramways, tramway undertaking, plant, &c., in Perth, Western Australia. Trustees: Lord Arthur Butler, 7, Portman Square, W.; and J. S. Austen, 68, Dashwood House, E.C. Previously issued of same series: £39,600.

Consolidated Supply Co., Ltd. (Electricians, Canonbury) (85,898).—Issue on January 1st of a £500 5 per cent. debenture, part of series created September 22nd, 1905, to secure £5,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Consolidated Electrical Co., Ltd., Broad Street House, E.C. No trustees. Previously issued of same series: £2,500.

Siemens Electric Appliances, Ltd. (75,102).—This company's annual return was filed on December 22nd, when the entire capital of £25,000 in 250 shares of £100 each had been taken up. £100 per share has been called up on 7 and £30 per share on 243 shares, resulting in the receipt of £7,990. Mortgages and charges: Nil.

W. T. Skelding & Co., Ltd. (74,817).—This company's annual return (made up to November 22nd last) was filed on January 4th, when 2,007 shares had been taken up out of a nominal capital of £10,000 in £1 shares. £1 per share has been called up on 7 and 18s. per share on 1,000 shares and £907 has been received. 1,000 shares are considered as fully paid. Mortgages and charges: Nil.

Sunderland District Electric Tramways, Ltd. (79,054).—A charge dated December 29th, 1905, to secure £2,500 and 6 per cent. interest, has been registered. Property charged: The company's undertaking and property, present and future (subject to trust deed dated December 8th, 1903, and £160,000 debentures issued thereunder), ranking *pari passu* with a charge for a like amount given to Bruce Peebles & Co., Ltd. Holder: Electric Conversion Syndicate, Ltd., 13, St. Helen's Place, E.C.

CITY NOTES.

Charing Cross, West End and City Electricity Supply Co.

AN extraordinary general meeting of the above company was held at the offices, St. Martin's Lane, on Wednesday, under the chairmanship of Mr. F. W. Fladgate to consider, and if thought fit pass, the following resolution:—"That the Bill submitted to this meeting, intituled 'A Bill to confer further powers upon the Charing Cross, West End and City Electricity Supply Co., Ltd. (Power Supply),' be and the same is hereby approved, subject to such additions, alterations or variations as Parliament may think fit to make therein and the directors shall sanction."

The CHAIRMAN, in moving the adoption of the resolution, said the necessity for bringing forward such a Bill, was in order to protect the interests of the company in the present state of competition for bulk powers of supply in the Metropolis. Last year there was an exceedingly strongly advocated measure brought forward by Mr. Merz for supplying the whole of the Administrative County of London, and the Charing Cross Co. also promoted a Bill to enable them to get additional powers. In the end both measures failed, but had they not promoted their Bill they would not have been in the position of making certain proposals for dealing with matters which arose from time to time, and which, had Mr. Merz's Bill been passed, would have been beneficial to their company. In the forthcoming session of Parliament other schemes were being brought forward. A very comprehensive scheme was being brought forward by the London County Council which deserved the gravest consideration; Mr. Merz's scheme was being brought forward on practically the same lines as last year, and a third comprehensive scheme was being brought forward, known as the St. Neots scheme, which also required the gravest consideration. It was under these circumstances that the directors, after careful consideration of all the circumstances had determined that it was in the interests of the company, and, in fact, that it was essential, that they should themselves promote a Bill for the purpose of enabling them to enlarge their powers, and to meet the opposing schemes which would be brought forward.

Mr. G. H. BROUGHAM GLASIER seconded the motion.

Mr. BIRCHAM (solicitor) explained the objects of the Bill which, briefly stated, empowers the company to supply electric energy to railway, canal, tramway and other companies whose undertakings may only be partly in the area of the company, and it extends the area of the company for power supply to Kensington, Westminster Holborn, St. Pancras, Islington, Finsbury, Shoreditch, Bethnal Green, Stepney, Poplar, Hackney, West Ham, East Ham, and to a large district in Essex, comprising, amongst other places, Woodford, Wanstead, Leyton, Ilford, Romford, Brentwood and Epping.

Replying to a question, the SOLICITOR said that Clause 25 exempted the undertaking asked for in the Bill from purchase by the local authorities at the end of 42 years, but that clause did not interfere with the right of local authorities to purchase their undertaking which was now being worked under provisional orders.

Mr. MAKINS said they all recognised that their interests were in the hands of a capable board, but it did seem to him that the whole question was rather in a muddle. It looked as if all the companies in London were going for powers of a similar character, and that, in addition, the L.C.C. and other companies were seeking these

powers. It seemed to him that the companies were all going to fight one another, and surely it would be better if they combined and showed a united front against the new comers.

Mr. Murray Law agreed with the last speaker, and thought they were going far beyond their position as an electric lighting company. If they were to supply railway and other companies they would want a great deal more capital, and the original shareholders would be left in a minority. He thought their energies ought to be taken up in competing with the gas companies, who were making tremendous strides in their own domain. He could not help wondering whether it would not be better to concentrate their energies in one place.

The Chairman said that not one of them had a stronger desire than he had to see a united policy on the part of the electric lighting companies, and he had devoted a great deal of time and energy in trying to bring that about. In the autumn of last year he thought that, owing to the efforts made principally by their company, some arrangement would have been made by which a united front would have been presented, but the attempt failed. He did not now despair, and had not left off working, and last Friday he was able to bring about a meeting of 11 of the companies for a joint discussion. At the same time, they dare not allow themselves to be left in the lurch, and unless they had promoted that Bill they would have laid themselves open to that chance. Had they had the power to supply a railway three years ago, they would have been able to have completed a most satisfactory contract with a railway company, and it was such things as that which made them quite certain that they were following the right policy in placing themselves in the position of not being left. It was true that the gas companies were doing all they could, but their company had, so far, lost practically nothing, and through the energy of their officers they had endeavoured to push their business by opening something in the nature of an electrical exhibition in Fenchurch Street. He believed that if they only combined the existing companies could supply all the power that was required in London, and it was some such arrangement that he tried to bring about last year. However, they failed, and they were now left to do the best they could with the new would-be competitors.

The resolution was then agreed to.

Metropolitan Railway Co.

At the half-yearly meeting last week, Sir Charles McLaren, Bart., M.P. (chairman), said an important factor in their receipts was the number of passengers carried during the half-year. They were now within 356,000 of the number carried before the Central London Railway was opened, which at that time, he said, was a blow to their traffic. They might reasonably hope next year they would have a record number of passengers. The traffic in London was increasing, notwithstanding the competition of tubes and of motor and other omnibuses, and their passenger traffic had all but touched the highest level of their very best days, when this competition did not exist; as soon as they had got the electrical installation completely finished and at work they would, he felt confident, show a relatively large increase. In making the change from steam to electrical working they had to incur practically the full expenses of both forms of traction for a time, and, although they had a decrease on their steam expenses of over £14,000 this half-year, the extra and duplicate machinery which they had to keep up and in working order had been responsible for the expense which they would not have in the future to incur. When they last met he did not hold out any very rosy prospects for the half-year. He reminded them that they had raised and spent additional capital on their electrification works, and that, for various reasons, they were not yet actually in a position to reap the full benefits of the new mode of working. To a large extent that state of things had continued up to the present time, though they were, of course, in a very much more advanced position now than they were six months ago, and were within measurable distance of the time when steam would disappear entirely from their system. The expenses chargeable to the new electric working had been considerably greater than the saving they had been able to effect in locomotive power, and they proposed to adopt the same course as they did six months ago, and charge a part of the difference to their reserve fund, seeing that the extra expense was incurred very largely for experimental purposes, and was, of course, of an abnormal character. There were two things standing in the way of the complete withdrawal of steam from the tunnel sections of their line. The first was that the conversion of the Hammersmith and City Railway from steam to electricity was not yet complete, and the second that they had not yet got all the electric locomotives delivered. With respect to the electric locomotives which they required for hauling over the electrified portion of the line trains to and from places beyond Harrow, and also the Great Western trains on the Circle section, within the last few weeks they had received and tested and taken over from the contractors five of these locomotives, and they were now running experimentally in the Harrow service. The remainder of the engines on order would be delivered very shortly. He was glad to be able to say that the whole of their electric rolling stock, including locomotives and the equipment of the line and trains, had been ordered from British firms, and, so far as they knew, had been constructed in this country. He mentioned that because, as they were aware, there had been a very considerable amount of attention paid in the Press in the last few weeks to this question of the supply of rolling stock from some of the contracting firms in this country; for, as they were also aware, a large portion of rolling stock on the District Railway was ordered from foreign contractors. He felt that the success of their coaches, so far as the public were concerned, had been undoubted, and he did not think there could be any comparison between the advantages which their rolling stock offered with the rolling stock of other lines. Moreover, he thought they would find that their decision to buy their stock in this country had been a wise one, and he believed that in no instance had they paid more than they would have paid abroad. No doubt, many might wonder whether any explanation was to be given as to the stoppages and breakdowns which had undoubtedly occurred during the working of the electric service. They were sorry for these failures. They were due to faults arising from one cause and another in the motors and other equipment on the cars, and the contractors for the stock had been called upon to take up the matter seriously, with a view to ascertaining and eradicating all sources of weakness before the company finally took the stock over. The contractors were as anxious and as willing as the directors were to have this matter put thoroughly right, and he hoped this complaint would gradually disappear.

The meeting authorised the raising of additional capital to the extent of £800,000, with the usual borrowing powers, for the further money required to complete the electrification works in hand and for improvements at Baker Street.

Chatham and District Light Railways Co.

The report for the half-year ended December 31st last states that the result is as follows: — Receipts, £18,505; expenses, £12,800; and, after adding balance brought forward and deducting interest on debentures, there remains a balance of £7,273. Of this amount £2,000 has been transferred to reserve for depreciation, £387 written off as per revenue account, and the directors recommend a dividend at the rate of 3 per cent. per annum on the ordinary shares, carrying forward £699. During the half-year the balance of the additional capital referred to in the previous report—namely, £3,500—has been issued and fully paid up, half in preference shares and half in ordinary shares of £10 each, the proceeds having been utilised in reducing the company's indebtedness. The Rochester Corporation is proceeding with the construction of an extension line to Delce Grange, which will be leased to this company.

Anglo-American Telegraph Co.

The directors' report for the half-year ended December 31st states that the total receipts, including the balance of £1,253 brought forward from the last account, amounted to £204,953. The traffic receipts show an increase of £14,675, as compared with the half-year ended December 31st, 1904. The working expenses of the half-year, including those of the ss. *Minia*, pensions account, &c., as shown by the revenue account, amounted to £73,106, being an increase of £2,800, as compared with the corresponding period of 1904. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £5,000 to the renewal fund, leaving a balance of £126,847. Quarterly interim dividends of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, were paid on November 1st last, absorbing £52,500, leaving a balance of £74,347, out of which the directors recommend the proprietors to declare final dividends of £1 1s. per cent. on the ordinary stock, £1 12s. per cent. on the preferred stock, and 10s. per cent. on the deferred stock, payable on February 3rd, amounting together to £73,500, making a total distribution for the year ended December 31st, 1905, of £3 5s. per cent. on the ordinary stock, £6 per cent. on the preferred stock, and 10s. per cent. on the deferred stock. The balance of £846 16s. will be carried forward to the next account.

Direct United States Cable Co.

Mr. E. M. Underdown, K.C., presided at the half-yearly meeting held at Winchester House on Tuesday. After referring briefly to the figures in the report (see Electrical Review, January 26th, p. 149) he said that the revenue when compared with the corresponding period of 1904 showed an increase of £5,323 due to the continued improvement in the traffic. This company was a sort of barometer of the state of business between this country and the U.S., and when commercial relations were active the cables felt it. The working expenses in London were practically unaltered, and at the stations there was a small increase because of the increased traffic handled. The working expenses were £1,190 up, but they now included provision for the staff pension fund. To earn an increase of £5,323 in the revenue they had to make an additional outlay of £1,190. During some considerable period they had had no charge against the reserve fund. They had been singularly fortunate in escaping large expenditure for repairs, and they had gone on according to the very prudent plan of continually adding to the reserve fund and making use of the interest accrued on the investments for bringing it up to a sum that would be regarded as equivalent to their possible requirements taken reasonably. This half-year they had credited the interest £7,753 and added £10,000 to the reserve fund, and he had now the satisfaction of informing them that they had reached the reserve sum that they had been for a long while ambitious to obtain. That fund now stood at £500,700, the cost of the investments, but the actual value was slightly in excess of that amount. Having reached the present point, the board felt that it could, with justice and prudence, give the share-

holders the advantage of, if not all, a very substantial amount of the whole net profits. Of course, he did not mean that they were going to allow the reserve fund to be depleted. It might be that, if it were decreased by any amount, they would have to replace it, but on the whole they might take it that if their experience in the future was, as in the past, the interest on the fund would cover their ordinary repairs. They had on this half-year, therefore, been able to give ½ per cent. more, and they trusted all the conditions were favourable. Their lines were in excellent order; in fact, all the cables of themselves and their friends in the pool were in good condition, which, of course, tended to the prosperity of everyone connected with the pool. In regard to the future, he hoped they could count upon continued prosperity, such as they now enjoyed. After mentioning the death of M. Despecher, announced in that day's papers, and regretting the disappearance of one more of the great landmarks of telegraphy, the chairman formally moved the adoption of the report.

Sir James Pender seconded the motion, which was carried unanimously.

The meeting voted its thanks to the directors and staff.

City and South London Railway Co.

The directors' report for the half-year ending December 31st, 1905, to be submitted to the half-yearly meeting on Tuesday, 6th inst., says that the receipts from all sources for the half-year amounted to £74,714, and the cost of working has been £34,848, leaving a profit of £39,865. Inclusive of the balance brought forward, the net revenue account shows an aggregate total of £41,400. After making provision for the debenture stock interest, and the transfer to the renewal fund of £1,500, a balance remains available for dividend of £28,675. Out of this sum the directors recommend that the full dividend of 5 per cent. per annum be paid on the preference stocks, 1891, 1896 and 1901, and that a dividend at the rate of 1¾ per cent. per annum be paid upon the consolidated ordinary stock for the half-year, leaving a balance of £1,367 to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket-holders, and dividends paid in each half-year for several years past:—

Half-year ended	No. of passengers (exclusive of season ticket holders).	Receipts (including season tickets).	Dividend per cent. per annum on ordinary stock.
June 30th, 1902	£9,192,120	£76,843 12 3	3
December 31st, 1902	9,877,199	82,131 7 1	2¾
June 30th, 1903	9,511,450	78,384 19 9	2½
December 31st, 1903	8,711,062	72,286 3 6	2
June 30th, 1904	9,226,987	76,387 14 1	2¼
December 31st, 1904	8,401,846	70,705 10 11	1¾
June 30th, 1905	8,662,588	71,802 7 8	2
December 30th, 1905	8,607,486	70,103 14 4	1¾
Total since opening of line ..	151,979,188	1,217,522 15 0	—

Railway opened for traffic December 18th, 1890.
Extension to Moorgate opened February 25th, 1900.
Extension to Clapham Common opened June 3rd, 1900.
Extension to Islington opened November 17th, 1901.

With deep regret the directors record the death of their highly esteemed colleague, Mr. Charles Grey Mott, who had been chairman of the company from its inception, and they desire to express their warm appreciation of his valuable services and unfailing devotion to the interests of the company. They have elected the Right Hon. C. B. Stuart-Wortley, K.C., M.P., to fill the vacancy on the board, and have elected him chairman of the company. Satisfactory progress is being made with the construction of the extension to Euston. The contract for the lifts for the extension has been placed with the Otis Elevator Co., Ltd. An agreement has been made with the London and North-Western Railway and the Charing Cross, Euston and Hampstead Railway Companies as to the interchange station and connecting subways with the former company's platforms at Euston Station. The contract for the works and lifts, and the contract for the joint subway connecting this company's platforms with those of the Charing Cross, Euston and Hampstead Railway, have been entered into. At the Elephant and Castle Station the subway communication between this company's platforms and those of the Baker Street and Waterloo Railway is nearing completion.

Dublin and Lucan Electric Railway Co.

The directors' report for the half-year ended December 31st, 1905, shows that the receipts on revenue account from all sources are £3,328, being £8 less than for the corresponding period of 1904, while the total expenditure was £1,785, an increase of £89. After providing for debenture interest there is an available balance of £1,305, out of which the directors recommend payment of the half-yearly dividend (£475) on the 5 per cent. preference shares to December 31st last, and £500 to the electrical contractors on account of the sum remaining due to them for electrical equipment, leaving a balance of £330 to be carried forward to next half-year. The total amount applied out of the revenue of 1905 in reduction of capital expenditure on electrical equipment is £900.

The line is 7 miles long, and the train mileage for the half-year was 57,878 (including 56,700 for passenger, and mixed passenger and goods trains, and 1,178 for goods train).

South London Electric Supply Corporation.—Subject to final audit the directors recommend a dividend on the ordinary shares at the rate of 4 per cent. for the past year, with an increased carry forward. The dividend last year was at the same rate.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to—

W. T. Henley's Telegraph Works Co., Ltd.—£150,000 4½ per cent. first mortgage debenture stock.

And to allow the following securities to be quoted in the Official List:—

Westminster Electric Supply Corporation, Ltd.—Further issue of 3,128 4½ per cent. cumulative preference shares of £5 each, fully paid; and 50,000 4½ per cent. cumulative preference shares of £5 each, £1 paid.

The Committee has appointed a special settling day as under:—

Wednesday, February 7th—Bombay Electric Supply and Tramways Co., Ltd.—60,000 6 per cent. cumulative preference shares of £10 each, £4 paid, Nos. 15 to 60,000 and 119,987 to 120,000; and £600,000 4½ per cent. debenture stock.

The Committee has also ordered the undermentioned to be quoted in the Official List:—

White (J. G.) & Co., Ltd.—15,000 6 per cent. cumulative preference shares of £10 each, fully paid, Nos. 1 to 15,000.

Montreal Light, Heat and Power Co.—A dividend has been declared for the three months ending January 31st at the rate of 4 per cent. per annum.

Blackpool and Fleetwood Tramroad Co.—The directors recommend a dividend for the half-year ended December 31st last at the rate of 9 per cent. per annum, placing £750 to depreciation reserve, £250 to general reserve, and carrying forward £1,798.

Waterloo and City Railway Co.—The directors recommend a dividend on the ordinary stock at the rate of 3½ per cent. per annum for the half-year ended December 31st, 1905, carrying forward £380. The dividend for the corresponding period of 1904 was at the same rate.

Douglas Southern Electric Tramways.—The directors' report states that the company's season this year consisted of 114 days, as against 134 days last season, while the mileage run was 33,313·59 as against 35,079·97 last year. The season has been a fairly successful one, the number of passengers carried being 210,298. The service has been well maintained. The total receipts for the season were £5,107, as against £4,786 in 1904. The net profit for the year was £1,745, as against £1,682 last year, which, added to £182 balance from last year, gave a total disposable balance of £1,927. The directors recommend a dividend of 6 per cent. upon the preference shares, which will absorb £1,558, and leave a balance of £369 to be carried forward, subject to directors' fees.

Prospectuses.—*Edmundson's Electricity Corporation, Ltd.*—A circular has been issued among the shareholders and debenture stock-holders inviting them to subscribe for an issue of £83,000 of 4½ per cent. first mortgage debenture stock at 104 per cent. The share capital issued and fully paid amounts to £800,000, and there has also been issued £352,000 of debentures, with which the new issue will rank *pari passu*.

The Shelford Rubber Estate, Ltd.—This company has been offering 43,334 £1 ordinary shares for public subscription at par. The company has been formed to acquire and work the Estate of Shelford, Selangor, Malay States. 520 acres of the estate are fully planted with over 100,000 Para rubber trees, of which 10,500 are already of bearing age.

The Fodal Copper and Sulphur Co., Ltd.—This company is offering (the list closes to-day) 120,000 preferred ordinary shares of £1 each for subscription at par. The company's mining estates are in Norway. For the 270,000 tons of ore in sight, the value is stated to be 2 per cent. of copper and 48 per cent. of sulphur. Messrs. H. R. Merton & Co. have contracted to dispose of the company's products.

Bournemouth and Poole Electricity Supply Co.—The transfer books will be closed from 6th to 14th inst., preparatory to the payment of the dividends due on the 4½ per cent. preference, and the 6 per cent. second preference shares, for the half-year ended December 31st.

National Gas Engine Co.—The report of the directors for the year ended December 30th, states that the net profit is £40,014. After providing interim dividends on the preference and ordinary shares, and adding £2,566 brought forward, it is proposed to pay a final dividend at the rate of 15 per cent. per annum for the six months ended December 30th, and a bonus of 1s. per share, on the ordinary shares, leaving a balance of £16,403, out of which the directors propose to place £10,000 to the reserve fund (making it £60,000), to write off the sum of £635 for expenses and stamp duties attendant on the increase of capital to £400,000, and to carry forward £5,767.

Reduction of Capital.—On February 13th Mr. Justice Warrington, sitting in the Chancery Division, London, will hear a petition to confirm a special resolution reducing the capital of Elmore's German and Austro-Hungarian Metal Co., Ltd., from £162,981 to £115,745.

Westminster Electric Supply Corporation.—The directors recommend a dividend at the rate of 13 per cent. per annum for the half-year ended December 31st, 1905, making 13 per cent. for the year. This compares with a total of 14 per cent. for 1904.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	* £	No. of wks.	Total to date. £	* £	Route miles open.	*
Aberdeen	Jan. 27	2,263	+ 96	35	48,767	— 980	..	..
†Ayr	,, 20	170	+ 5	35	11,119	— 109	8	..
Bath	,, 27	1,312	+ 329	4	2,616	+ 476	18	..
Belfast	,, 26	5,758	+1,575	4	11,618	+ 2,766	40	+ 6½
Birkenhead	,, 28	1,931	+ 137	43	44,763	— 499	18·5	..
Blackburn	,, 24	1,679	+ 302	43½	42,287	+ 2,145	13·75	..
Blackpool Corp.	,, 25	605	+ 99	43	46,618	+ 1,970	11·87	..
,, —Fleetw'd	,, 27	322	— 12	4	645	— 37	..	..
,, —Lytham	,, 25	276	+ 45	12	1,808	+ 208	7½	..
Bolton	,, 28	3,500	+ 365	44	84,392	+ 4,101	26	+ 1
Bournemouth	,, 24	2,652	+1,052	42½	60,960	+13,887	17·4	+ 7½
Bradford	,, 27	7,685	+ 640	43	188,257	— 3,227	53	..
Brighton	,, 28	1,474	+ 37	44	43,885	..	9·5	..
Bristol	,, 26	9,351	+ 756	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	Jan. 19	422	+ 66	3	644	+ 88	8·5	..
Barrow	,, 19	389	+ 41	,,	520	+ 54	5·37	..
‡Birmingham (City)	,, 19	10,357	+ 317	,,	14,152	— 289	14·5	..
Birmingham (Mid.)	,, 19	2,079	— 459	,,	3,637	— 732	12·25	..
Devonport	,, 19	842	— 42	,,	1,168	— 60	8·85	..
Dudley—Sto'rb'ge	,, 19	1,508	+ 192	,,	2,009	+ 225	21·25	..
Gateshead	,, 19	1,805	+ 163	,,	2,489	+ 187	11·25	..
Gravesend, N'fleet	,, 19	413	+ 41	,,	540	+ 48	6·5	..
Gr'n'k, Pt. Glsgw	,, 19	1,496	+ 147	,,	1,591	+ 168	7·25	..
Hartlepool	,, 19	485	+ 36	,,	676	+ 34	6·72	..
Leamington	,, 19	275	+ 100	,,	383	+ 140	..	..
Merthyr	,, 19	345	+ 20	,,	464	+ 23	2·9	..
‡Metropolitan	,, 19	5,608	+1,890	,,	7,468	+ 246	..	..
Middleton	,, 19	564	+ 72	,,	758	+ 102	8·5	..
Oldham — Ashton	,, 19	1,016	+ 77	,,	1,357	+ 92	9·13	..
Peterborough	,, 19	207	+ 5	,,	270	+ 2	5·31	..
Potteries	,, 19	3,568	+ 376	,,	4,716	+ 401	29	..
Rothesay	,, 19	87	+ 15	,,	172	+ 31	2·75	..
Southport	,, 19	448	+ 57	,,	652	+ 36	8·17	..
South Staffs.	,, 19	1,517	+ 309	,,	2,031	+ 391	13·87	..
Swansea	,, 19	1,454	+ 584	,,	1,972	+ 787	5·5	..
Tynemouth	,, 19	324	+ 10	,,	445	— 2	3·75	..
Weston-s-Mare	,, 17	53	— 7	,,	64	— 7	3	..
Wolverhampton D.	,, 19	744	+ 133	,,	951	+ 93	14·75	..
‡Worcester	,, 19	457	+ 32	,,	683	+ 25	5·75	..
Yorks. Wool. Dist.	,, 19	1,649	+ 590	,,	2,147	+ 895	17	..
Miscellaneous	,, 19	850	+ 82	,,	1,119	+ 20	.	..
Burnley	,, 27	2,092	+ 270	..	..	..	7·5	..
Burton-on-Trent	,, 28	530	+ 6	43	18,363	— 1,486	8·5	..
Bury	,, 21	1,615	..	42	31,906	..	10·5	..
Cardiff	,, 20	3,936	+ 231	42	86,397	+ 60	15·8	..
Carlisle	,, 27	316	+ 59	4	653	+ 55	..	..
Chatham and Dist.	,, 25	1,152	+ 87	4	2,157	+ 56	9·33	+ 8
Cheltenham	..	..	..	..	..	..	..	..
Colchester	,, 24	306	— 21	26	4,858	..	7	..
Cork	,, 25	809	+ 20	4	1,508	+ 6	9·89	..
Coventry	Dec. 14	815	+ 8	50	23,960	+ 642	9·89	..
Darlington	Jan. 27	574	+ 39	43	8,783	..	4·87	..
Darwen	,, 26	480	+ 99	43	10,511	+ 647	4·36	..
Dover	,, 27	351	+ 35	43	9,752	+ 35	4·75	+ 1¼
Dublin	,, 26	9,109	+ 562	4	17,332	+ 952	48·5	+ 1·5
Dundee	,, 24	1,887	+ 337	36	33,927	+ 2,656	12·5	..
East Ham	,, 27	1,608	+ 421	43	35,755	+ 4,937	8	+ 1¼
Exeter	..	..	..	..	..	..	..	..
Glasgow	,, 27	30,003	+2,990	34	534,019	+33,941	76	+ 3·5
†Gloucester	,, 17	249	+ 46	42	12,359	..	15	..
Halifax	,, 24	2,570	+ 374	43	67,510	+ 4,852	37	+ 2·5
Hastings	,, 25	738	..	..	..	..	..	..
Huddersfield	,, 27	2,617	+ 392	43	58,860	+ 3,220	28	..
Hull	,, 27	4,407	+ 448	43	96,339	+ 1,817	13	..
Ilford	,, 27	806	+ 161	43	20,304	+ 892	..	..
Ilkeston	,, 24	215	+ 27	43	5,088	— 709	3·5	..
Ipswich	,, 27	632	+ 32	43	18,503	— 1,827	10·5	..
Isle of Thanet	,, 27	470	+ 49	4	934	+ 61	..	..
Kilmarnock	..	..	..	..	..	..	..	..
Kirkcaldy	,, 24	370	+ 19	..	..	..	7·5	..
Lan'kshire Trm. Co.	,, 25	1,563	+ 412	4	3,269	+ 735	13·5	+ 3·9
Leeds	,, 19	11,107	+ 935	42	253,711	+ 7,843	89·5	+ 8
Leicester	,, 27	3,922	+ 631	4	7,764	+ 1,361	..	..
Leith	..	..	..	..	..	..	..	..
Lincoln	..	..	..	..	..	..	..	..
Liverpool	,, 20	20,624	+1,415	3	30,268	+ 1,657	104	+ 1
L.C.C.	,, 13	27,859	+2,550	41	606,760	+81,963	51	+ 4½
Lowestoft	,, 27	245	+ 22	17	2,480	— 2	3·5	..
Manchester	,, 27	24,119	+2,046	43	554,580	+28,050	..	..
Nelson	..	..	..	..	..	..	..	..
Newcastle	,, 27	7,365	+ 395	43	164,197	+ 4,429	..	..
Newport	,, 20	1,125	+ 130	16	8,800	+ 654	14·5	+ 1·5
Northampton	..	..	..	..	..	..	..	..
Oldham	,, 28	3 078	+ 412	44	72,002	+17,125	23·75	+ 1·6
Plymouth	..	..	..	..	..	..	..	..
Pontypridd	,, 27	277	..	43	6,934	..	3·5	..
Portsmouth	,, 27	2,898	+ 293	43	84,676	+ 1,654	14·5	..
Preston	,, 24	1,176	..	..	..	..	..	..
†Reading	,, 18	603	+ 67	42	26,603	— 477	..	..
Rochdale	,, 27	1,507	+ 762	43	33,771	+22,767	21·3	+ 5·8
Rotherham	..	..	..	..	..	..	..	..
Salford	,, 22	8,169	+ 750	43	183,622	+10,932	..	..
†Scarborough	Nov. 25	49	..	46	7,735	..	4·5	..
Sheffield	Jan. 28	9,732	+1,159	44	217,684	+12,568	35·75	-1·5
Southampton	,, 24	1,748	+ 129	16	14,453	— 100	..	..
Southend-on-Sea	,, 24	494	+ 85	43	16,268	+ 1,000	6	..
Stalyb'dge, Hyde, &c.	,, 20	1,132	+ 347	42	26,940	..	21	..
Stockport	,, 19	1,462	+ 664	42	32,033	+ 8,664	15·5	+ 4
Sunderland	,, 28	2,399	+ 273	43	57,219	+ 2,506	..	..
Swindon	,, 24	321	+ 30	43	8,375	..	4·4	..
Tyneside	,, 17	664	+ 48	3	819	— 6	8·87	..
Wakefield	..	..	..	..	..	..	..	..
Warrington	,, 18	685	+ 87	42	14,389	+ 586	6·37	+ ·25
West Ham	,, 25	3,849	+1,863	42	78,860	+33,954	14·7	+ 4·9
Wolverhampton	,, 24	1,531	..	..	..	..	10	..
Cen. London Rly.	,, 27	13,880	— 745	4	27,875	— 1,127	6	..
City & S. Lon. Rly.	,, 29	6,037	— 101	4	12,210	— 169	6·25	..
Dublin-Lucan Rly.	,, 26	170	— 6	4	329	— 32	7	..
G. N. and City Rly.	,, 27	3,591	+ 42	4	7,234	+ 127	3·5	..
L'pool Overh'd Rly.	,, 28	2,778	— 134	4	5,638	— 259	6·65	..
Mersey Railway	,, 27	3,314	+ 56	4	6,816	+ 197	4·5	..
Metropolitan Rly.	,, 28	34,126	— 130	4	68,823	— 173	70·5	
Met. District Rly.	,, 28	16,164	+ 921	4	32,561	+ 2,051	24	
Anglo-Argentine	,, 28	28,344	+2,881	4	58,437	+ 5,081	..	..
Auckland, N.Z.	..	..	..	..	..	..	..	..
Brit. Columbia Rly.	Dec.	21,953	+3,510	26	123,211	+27,557	..	..
Bu'n's A'r's E.T. Co.	,, 30	2,895	..	52	62,596	..	..	..
Bu'n's A'r's-Belgr'no	Jan. 21	6,844	+ 555	3	10,903	+ 1,060	..	..
Calcutta	,, 27	5,745	+ 471	..	..	..	..	..
§Geneva	Dec.	6,496	+ 89	..	..	..	..	..
Perth (W.A.)	Jan. 26	3,209	+ 143	4	6,047	+ 223	24·25	+ 5½

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Wednesday afternoon,

NOTWITHSTANDING the fact that the General Election of January, 1906, has now become ancient history, to which no more than a passing reference is, therefore, permissible, the Stock Exchange still suffers from the lack of business that was ascribed a fortnight ago to political excitement. Consols are good, but Home Railway stocks have become extremely flabby, and, as regards the stocks of the electrified Undergrounds, Districts and Metropolitans are flat. Electricity Supply shares possess the negative virtue of having ceased to fall, for the time being, while the Telegraph stocks have also stopped rising, after their continuous improvement for so many weeks.

Metropolitan Consolidated is down to 84, a drop of three points since the beginning of the year, and there is very little public support accorded to the stock. The traffics are poor; electrification, so far, has spelt disappointment. The price has not been as low as its present level since 1904, when 83 was touched, and the lowest quotation of recent years was 69, recorded in 1901. These are somewhat different figures to the 137 attained in 1898, when the company paid no more than 3¾ per cent. dividend. Last year the price rose at one time to par.

Districts at 34 are also weak, in spite of a small increase in the traffic, and are only a point above the lowest touched last year, although in 1900 they went to 21¼, rebounding to 44½ four years later. It is said in the City that the company is to pay Sir George Gibb £10,000 a year, and if that gentleman can make the District pay, his services will be worth far more than that sum.

Friendly relations between the Underground companies and the Tubes are now under discussion, and the general hope of everyone concerned—stockholders and travellers—will be for some kind of a working arrangement. City and South London stock drooped to 43, the figures of the report showing that the concern makes little headway. Central Londons are unchanged, and the dividends of 4 per cent. met anticipation. There is a better tone in Waterloo and City, the price moving up a couple of points on the idea that the line will shortly be taken over by the parental London and South-Western Railway. Charing Cross, Euston and Hampstead 4 per cent. certificates are 96, Great Northern, Piccadilly and Brompton Fours 97, and Baker Street and Waterloo 4 per cent. Debenture is 101.

Apologists for electric traction—it may perhaps be wondered why champions need arise for such an obvious necessity—are trying to make great capital out of their newly-discovered fact that the steam railways are advantaged by electric trams rather than the reverse. This is, of course, apparent to those who have studied the question with any degree of care, but it forms no reason for optimism regarding companies such as the London United Tramways or the British Electric Traction. The Preference shares of the former are 10s. lower at 9, and there can be no doubt that proprietors are growing uneasy at the company's neglect of provision for depreciation. British Electric Tractions have not recovered from their depression of last week, but for them the outlook is more hopeful now that the concern appears to have weathered some of the troubles until recently besetting it. Other traction issues are very little altered, Anglo-Argentine Preference, at 6, being a shade better. The Cape Electric Tramways is offering £150,000 5 per cent. "B" Debentures at 90 per cent.

After the experience of the Electric Lighting market since the Unionists found it impossible to dam the flowing tide in anything but the phonetic sense of the word, it is somewhat cheering to record but two falls in the share-list, and even these are partially off-set by one rise. St. James's Ordinary are another 5s. lower at 11⅞, on the decrease in the dividend, and Edmundson's Ordinary fell to 5, but except for these, there has been no downward fluctuations. Edmundson's Preference, curiously enough, are ⅛ harder. The market is certainly steadier, although the dealers are anything but keen upon making close prices. It is extremely unfortunate that the various forms of electrical power competition should have assailed the market at a time when dividends are difficult to maintain, but the shake-out has proceeded sufficiently far to discount eventualities both with reference to diminished distributions and threatened rivalry. From what we can gather in good quarters, the leading London companies are impressed with the wisdom of forming funds, under one name or another, with which to fight competition into defeat or compromise.

Several Construction shares are firmer. Electric Construction Preference rose to 2¼, and General Electric Preference to 9⅜, improvements of 2s. 6d. in each case. British Aluminium 4 per cent. Funding Certificates, too, are the same fraction higher at 3¼, and Henleys put on ½ at 13½, as did also Telegraph Constructions, which rise steadily almost every week. Cromptons at 2 1/16 have rallied a trifle.

Anglo-American Deferred is a strong market with another rise of 1⅜, and Direct United States have 10s. improvement to their credit at 15½. After being better, Submarines rose 2, and both the Globe shares are better, allowing for the dividends. Marconi's provided a mild cause for interest by rising 3/16 to 1½, someone apparently being caught out of the shares. Telephone descriptions have not altered.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905. §	Closing Quotations Jan. 24th.	Closing Quotations Jan. 31st.	Business done week ended Jan. 31st, 1906. Highest	Lowest.	Rise + or Fall —
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	98½ –101½	98½ –101½	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3⅜ — 4¼	3⅜ — 4¼	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	83 — 88	83 — 88	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2¾%	3⅛%	65 — 67	65 — 67	66⅜	65⅞	..
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅝%	6 %	114 —115	114 —115	114⅜	113⅞	..
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	⅛%	18 — 18¼	18⅛ — 18⅜	18 7/16	17⅞	+ ⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	102 —104	102 —104	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7⅞ — 8⅛ xd	7⅞ — 8⅛	8⅛	8 1/16	..
1,932.856£	Commercial Cable Stng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	¼ %	97 — 99⅜	97 — 99	99¼	98⅜	— ¼
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %§	8½ — 9	8½ - 9	8 3/16	8⅛	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %§	17 — 18	17 — 18	17⅛	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %§	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %§	8¼ — 8⅞	8¼ — 8⅞	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..
60,710£	Direct United States Cable	20	3¼%	3 %	3¼%	2½%	14½ — 15½	15 — 16 xd	16	15	..
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	5 %§	148 —151	148 —151	150	148½	..
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%§	92 — 94	91½ — 93¼	93¼	91	— ¾
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %§	109 —109¼	107⅛ —109½	109	107⅛	— ¼
300,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	6 %§	14½ — 15 xd	14½ — 15	14⅞	14⅝	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %§	107 —109	107 —109	..	..	..
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅝%	5 %	11⅛ — 11⅜	11⅛ — 11⅜xd	11⅜	11⅛	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅛ — 14⅜	14⅜ — 14⅝xd	14 7/8	14⅛	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	..	37½ — 39½	37½ — 39½	37⅞	..	..
42,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	5 %	57 — 59	57 — 59	58⅛	..	..
251,127	Marconi's Wireless Telegraph	1	..	..	..	..	1⅛ — 1⅜	1 1/16 — 1 1/16	28/9	26/3	+ 1/16
72,680	Monte Video Telephone Co., Ltd. Ord. ..	1	3 %	3 %	4 %	..	⅞ — 1	⅞ — 1	19/-	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞ — 1	⅞ — 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %§	113 —114	113 —114	113⅞	113⅜	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %§	110 — 112	110 —112	111⅛	110⅞	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %§	13 — 15	13 — 15	13⅝	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %§	11 — 13	11 — 13	12 1/16	12	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %§	5⅝ — 5¾	5⅝ — 5¾	..	..	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99½ —100½	99½ —101½	100½	99⅝	+ ½
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	104 —106	104 —105	104½	104½	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6¾%	6 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1¼ — 1⅜	1¼ — 1⅜	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	96 — 98	97 — 99	..	..	+1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %§	7½ — 7¾	7½ — 7¾	7⅞	7⅞	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red. ..	100	..	..	..	4½%	101 —104	102 —105	..	..	+1
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	125—128	127 —130	127½	..	+2
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7⅜ — 7½	7⅛ — 7½	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —112	110 —112	..	..	..
15,600£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅛ — 10	9⅛ — 10	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99½ —101½	99½ —101½	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14½ — 14⅝	14½ — 14⅝	14⅝	14 1/16	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	100 —102	100 —102	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	6 %	8½ — 8⅝	8½ — 8⅝	8 1/16	8 1/16	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6½ — 7½	6½ — 7½	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	6 %§	8⅜ — 8⅞	8⅜ — 8⅞	8¾	..	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅝ — 6⅛	5⅝ — 6 1/16	6	5 13/16	— 1/16
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	140 —143	140 —143	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	..	..	..
800,000	Babcock & Wilcox, 1 to 530,000	1	..	17 %	20 %	16 %‖	3⅜ — 4	3⅜ — 4	77/6	..	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅞ — 2	1 7/8 — 1 15/16	..	..	..
40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	3/6	5⅛ — 6	5⅛ — 6	..	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	3/-	5 — 5⅛	5 — 5⅛	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	..	2⅞ — 3⅛	3 — 3⅛	..	..	+ ⅛
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	98 —102	98 —102	..	..	..
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	..	120 —123	120 —123	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	..	110 —113	110 —113	111½	111	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	108 —111	108 —111	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105%	103 —105 %	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	101 —104 xd	101 —104	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	8⅛ — 8⅜	8⅛ — 8⅜	8 1/8	8⅛	..
161,497	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	10½ — 11	10½ — 11	10 3/8	10⅛	..
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	119 —121	119 —121	119⅛	..	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	98 —100	98 —100	99⅛	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %§	7 — 7¼	7 — 7¼	7¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %§	6 — 6½	6⅜ — 6½ xd	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	98 —100	98 —100	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅜ — 2⅛	1⅜ — 2⅛	42/6	40/7½	..
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	77 — 82	77 — 82	80	79½	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	1⅞ — 2	1⅞ — 2	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	..	2⅜ — 2⅝	2⅜ — 2⅝	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1¼ — 1⅜	1¼ — 1⅜	31/3	29/-	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	83	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	..	3⅜ — 3⅝	3⅜ — 3⅝	76/3	75/-	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	..	5⅜ — 6	5⅜ — 6	..	..	..
27,500	Do. "B" do. 1 to 27,500	5	..	6 %	6 %	..	5¼ — 5⅜	5¼ — 5⅜	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	105 —107	105 —107	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	101 —104	101 —104	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	7 %§	9¼ — 10	9¼ — 10	9⅞	9	..
32,610	Do. 105,001 to 137,610	5	..	..	..	3d.	8¼ — 9¼	9 — 9¼	..	..	+ ⅛
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4 %	4½%	104 —106	104 —106	105½	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10%	11 — 12	11 — 12	11	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝xd	5⅜ — 5⅝	..	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108½ —110½	..	..	+1
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅞ — 1⅛	⅞ — 1⅛	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/16	..	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	..	..	..
1,939,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	95 — 97	95 — 97	96½	95	..
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	104 —106	104 —106	105	104½	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	86 — 89	86 — 89	88½	88	..
1,480,000	City and South London Railway	Stock	3⅛%	2⅜%	2⅜%	1⅞%	43 — 45	42 — 44	43⅜	43	—1
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	..	1⅞ — 2⅛	1⅞ — 2 1/16	42/6	41/3	+ 1/16
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	96 — 99	97	..	+1

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	§1905.	Closing Quotations Jan. 24th.	Closing Quotations Jan. 31st.	Business done week ended Jan. 31st, 1906. Highest	Lowest.	Rise + or Fall−
52,000	Dick, Kerr & Co., 1 to 52,000	† 5	..	..	10 %	..	8¼— 9	8¼— 9	..	..	..
61,000	Do. do. 6 % Cum. Pref., 1 to 61,000	5	..	6 %	6 %	6 %	5½— 6¼	5½— 6¼	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	104 —106	104 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½%	6 %	6 %	13¼— 14½	13⅜— 14⅜	..	..	+ ⅛
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14½— 15⅝	14½— 15⅝	14⅝	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
300,000	Do. 3½ % "A" Debs.	100	..	3½%	3½%	3½%	98 —100	99 —101	..	..	+1
300,000	Do. 3½ % "B" Deb. Stock	100	..	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261	5	Nil	Nil	2½%§	..	1⅜— 1⅝	1⅜— 1⅝	31/-	28/9	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½%§	..	2¼— 2⅜	2⅛— 2⅜	47/6	..	..
344,023	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	92 — 97	92 — 97	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	⅛— ⅜	⅛— ⅜	..	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	1¾— 2⅜	2 — 2⅛	..	..	+ ⅛
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	90 — 93	90 — 93	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9 — 9⅛	9¼ — 9⅜	9⅛	9 7/16	+ ⅛
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	96 —100	96 —100	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %§	5⅛— 5⅜	5 — 5⅛	5⅛	..	— ⅛
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10⅜— 11⅛	10⅜— 11⅛	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 —103	102 —103	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	10%§	12⅛— 13⅛	13 — 14	13 11/16	13½	+ ⅛
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛— 5⅝	5⅛— 5⅝	5 17/32	5 7/16	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	.. — ..	.. — ..	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10 %	5 %	10%§	18⅛— 19⅛	18⅛— 19⅛	19	18½	..
300,000	Do. do. 4% 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	3%	1½%	Nil	1⅞— 2⅛	1⅞— 2⅛	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6½— 7	6⅞— 7⅛	..	..	+ ¼
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	4 %§	10 — 11	10 — 11	..	..	..
399,930	Do. do. 60,008 to 100,000 (£4 paid)	10	..	8 %	6 %	4 %§	4 — 5	4 — 5	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	9⅛— 9⅜	8⅞— 9⅛	..	..	— ⅛
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	97 —100	97 —100	..	..	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	..	3/16— 3/8	3/16— 3/8	5/-	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1— 1 1/16	1— 1 1/16	..	..	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	104 —106	104 —106	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	5 — 5⅛	5 — 5⅛	..	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	..	8⅜— 9⅛	8⅜— 9⅛	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	9⅜— 10⅛	9⅜— 10⅛	9 11/16	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 — 106	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	10 %	34 — 36	34⅛— 36⅛	36	35	+⅛
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	98 — 99	98 — 99	..	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%§	94 — 97	96 — 99	..	..	+2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8⅓%	6 %§	..	..	2 — 2⅛	2 — 2⅛	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	..	..	4 — 4⅛	4 — 4⅛	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	82 — 87	82 — 87	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5½%	4 %§	5¼— 5⅜	5¼— 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	9 %	8⅜— 9⅛	8⅜— 9⅛	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	8⅝— 9⅜	8⅝— 9⅜	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	102 —105	102 —105	102½	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %§	5⅜— 6⅛	5⅛— 6⅛	..	..	..
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	5¼— 5⅜	5¼— 5⅜	5 1/16	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4⅜— 4⅝	4⅜— 4⅝	..	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	4½%	4⅜— 4⅝	4⅜— 4⅝	93/1½	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	101⅛	..	..
44,496	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	4½%§	5 — 6	5 — 6	5 11/16	5 5/16	..
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	5 %	11 — 12	11 — 12	11½	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	13⅛— 14¼	13⅛— 14¼	13½	..	..
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —126	122 —126	..	..	..
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	102	101	..
40,000	County of Durham Electrical Power, Ord.	2	..	..	..	..	1 15/16— 2 1/16	1⅞— 2⅛	..	..	..
50,000	Do. do. do. 5 % Pref.	5	..	..	..	..	5¼— 5⅝	5¼— 5⅝	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	4 %§	8⅜— 9⅛	8⅜— 9⅛	9	..	..
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	12⅜— 13	12⅜— 13	12⅞	..	..
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	5 %§	5 — 5¼	4⅞— 5⅛	5 1/16	5	— ⅛
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	5 — 5⅜	5⅛— 5⅜	5 1/16	5⅜	+ ⅛
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	104 —106	104 —106	105¼	105	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	4 %§	5¼— 5⅜	5¼— 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	102 —105	101 —104 xd	..	..	—1
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	8 %	8¼— 8⅜	8¼— 8⅜	..	..	..
10,000	Do. New (£5 10s. paid)	£3	..	8½%	8½%	8 %	7⅞— 8¼	7⅞— 8¼	..	..	..
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —101	98 —101	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98 —101	98 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12%	12 %	10 %	10¾— 11⅛	10¾— 11⅛	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101 xd	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	..	1⅜— 2⅛	1⅜— 2⅛	37/6	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅛— 5⅛	4⅛— 5⅛	..	..	..
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	100	99¾	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %§	8⅜— 9⅛	8⅜— 9⅛	9⅛	9	+ ⅛
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5¼— 5⅜	5¼— 5⅜	5 3/16	5⅜	..
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	107 —111	107 —111	..	..	..
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..
57,009	Newcastle-on-Tyne, 1 to 57,009	5	..	8 %	8 %	2½%§	8 — 8⅛	8 — 8⅛	..	..	..
17,991	Do. 57,010 to 75,000	5	..	..	..	2¼§	8 — 8⅛	8 — 8⅛	..	..	..
57,009	Do. 5 % Pref., 1 to 57,009	5	..	5%	5	5 %	6⅛— 6⅜	6⅛— 6⅜	..	..	..
17,991	Do. 57,010 to 75,000	5	..	..	..	2¼§	6⅛— 6⅜	6⅛— 6⅜	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	6 %	13⅜— 14⅛	13⅜— 14⅛	14	..	..
64,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	5 %§	6⅜— 6⅝	6⅜— 6⅝	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	11⅛— 12⅛	11⅛— 12⅛	11⅜	11⅛	— ⅛
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	7⅛	..	..
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	97 — 99	97 — 99	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	..	2 — 2⅛	2 — 2⅛	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	1½%	3 %	4 %	..	3 — 3⅛	3 — 3⅛	65/-	..	..
103,700	South Met. Elec. Lt. & Power Ord.	1	Nil	Nil	Nil	..	3/16— 5/16	3/16— 5/16	..	..	..
85,368	(Late Blackheath and Greenwich 7 % Pref.	1	Nil	7 %	7 %	7 %	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..
148,292	Dist. E.L.Co.) 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	105 —108	105 —108	107	106	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	4⅝— 4⅞	4⅝— 4⅞	96/3	92/6	..
30,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5 1/16	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	104 —106	104 —106	104½	104	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	10¾— 11⅛	10¾— 11⅛	11⅛	11	..
28,151	Do do. 4½ % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5⅜	..	..

Shares not officially quoted:—Mackay Companies, ord., 60—61¾. Pref. 74½—75.

† Unless otherwise stated all shares are fully paid. § Interim dividends.

Bank rate of discount 4 per cent. (September 28th, 1905).

PROCEEDINGS OF INSTITUTIONS.

The Measurement of High Frequency Currents and Electric Waves.

By Prof. J. A. Fleming, M.A., D.Sc., F.R.S.

(*Abstract of Cantor Lectures delivered before the* Society of Arts; *continued from page* 158.)

Measurement of High Frequency Current and Voltage.

The oscillograph is a kind of mirror galvanometer adapted to measure very rapidly changing currents. It consists of one or two loops of fine wire which carry a mirror, these loops being placed in a strong magnetic field. When an alternating current is passed through the wire it causes the mirror to vibrate to and fro, and a ray of light reflected from this mirror is also reflected from another mirror with its axis at right angles, which is vibrating in tune with the first. The ray of light is then reflected either on to a ground-glass screen or a sensitive photographic plate. In order to render the instrument available for recording non-periodic phenomena, I have adopted the following plan:—On the shaft of an alternator having a frequency of about 80, is fixed a disk of non-conducting material having brass sectors let into it. Against this disk three brass wire brushes press, in such a fashion that, as the alternator revolves, the middle brush is alternately connected, first to one and then to the other of the outside brushes, for a time equal to half a period of the alternator. If a condenser C, a battery of secondary cells B, and the oscillograph circuit O, are connected up, as shown in fig. 9, we can then employ the current from the alternator to drive the mirror

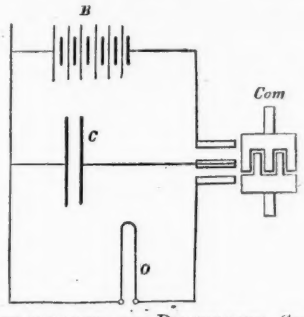


Fig. 9.—Arrangement for Delineating Condenser Discharge Curve.

of the oscillograph, and at the same time use the alternator shaft to drive the commutator, which alternately charges the condenser from the battery and discharges it through the oscillograph.* The result of this is that we get on the screen of the oscillograph curves representing the oscillatory discharge of the condenser. If R is the total resistance of the circuit including the oscillograph, and L is the inductance, the ratio $R/2L$ is called the damping factor, and denoted by the letter α. If C is the capacity of the condenser reckoned in microfarads, and L the inductance of the circuit in centimetres, then the quantity $\sqrt{CL}$ is called the oscillation constant of the circuit. It can then be shown that these quantities are connected by the following equations—

$$T = \frac{1}{n}\, p = 2\,\pi\, n = 6{\cdot}28\, n,$$

$$\delta = \log_\epsilon \frac{I_1}{I_2} = \log_\epsilon \frac{I_2}{I_3} = \&c.,$$

$$\epsilon\,\delta = \frac{I_1}{I_2} = \frac{I_2}{I_3} = \&c., \text{ where } \epsilon = 2{\cdot}718,$$

$$\alpha = R/2L = 2\,n\,\delta,$$

$$T = \frac{2\,\pi}{\sqrt{\frac{1}{CL} - \alpha^2}} \text{ or } n = \frac{1}{2\,\pi\,\sqrt{CL}}.$$

In making quantitative measurements we must measure capacity in microfarads and inductance in centimetres, and then the formula for the frequency becomes—

$$n = \frac{5 \times 10^6}{\sqrt{C \text{ (in mfd.)} \times L \text{ (in cm.)}}},$$

and the expression for the oscillation constant O becomes—

$$O = \sqrt{CL} = \frac{5 \times 10^6}{n}.$$

Also it can be shown that there is a certain relation between the first maximum ordinate I_1 of current, and the capacity of the condenser C, the voltage V, to which it is charged, and the frequency which is expressed by the following formula—

$$I_1 = \frac{C}{10^6}\, V\, p.$$

* In the actual experiments made in the Pender Electrical Laboratory, the time during which the condenser was in connection with the oscillograph was $\frac{1}{10000}$ of a second, and the times of charge and discharge were not quite equal.

For all practical purposes we may consider the oscillations to be over when they are reduced to 1 per cent. of their initial value. It is then easy to show that the number of complete oscillations M in the group or train is given by the formula—

$$M = \frac{4{,}606 + \delta}{2\,\delta}.$$

Suppose δ has any such value of 0·1, which means that each oscillation is about 90 per cent. of the preceding one. This means that in 23 or 24 oscillations, the discharge is finished. If, however, δ equals ·01, then there will be 230 to 240 complete oscillations in the train. In the case of oscillatory circuits as used in wireless telegraphy, in some cases there may not be half-a-dozen oscillations, in other cases as many as a thousand. As the operations of wireless telegraphy are greatly dependent upon the number of oscillations in a train, the measurement of the decrement is very important. We are now in a position to analyse completely the events which take place when a Leyden jar is attached to the secondary terminals of an induction coil, and has a spark gap and inductance placed in series with it, forming an oscillatory circuit with the spark gap.

We are concerned with the following five quantities:—First, the capacity, C, of the jar or condenser; second, the inductance, L, of the circuit; third, the maximum voltage, V, to which the jar is charged; fourth, the number of discharges per second, N; and fifth, with the mean square value of the current in the oscillatory circuit, J^2. Fig. 10 shows a hot-wire instrument which I have had made.

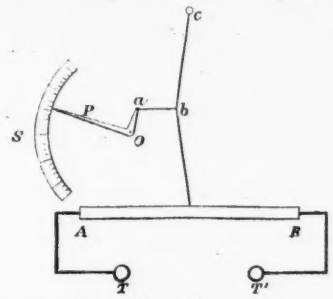


Fig. 10.—Hot-Wire High Frequency Ammeter.

It is not difficult to show that there is a definite relation between the root-mean-square value of a train of oscillations, the maximum value I of the first oscillation, the logarithmic decrement δ, and the frequency n, which is expressed by the following formula:—

$$J^2 = \frac{N\,I_1^2}{4\,a} = \frac{N\,I_1^2\,L}{2\,R} = \frac{N\,I_1^2}{4\,n\,\delta}.$$

Returning, then, to the Leyden jar discharge, we place a hot-wire ammeter in the discharge circuit and also a spark counter, and make use of a discharger, consisting of two spark balls of steel, each ball being about 2 centimetres in diameter, the distance between the balls being adjustable and measurable by means of a micrometer screw. There is a definite relation between the voltage required to give a spark of any length in air at the normal pressure, and the size of the spark balls, which is given in Table IV., mostly taken from Heydweiller's observations of spark potential.*

Table IV.—Showing the Spark Voltage between Brass Balls, 2 Centimetres in Diameter, for various Spark Lengths.

Spark length in cm.	Spark voltage.	Spark length in cm.	Spark voltage.	Spark length in cm.	Spark voltage.
0·1 ...	4,700	1·8 ...	44,700	3·5 ...	61,100
0·2 ...	8,100	1·9 ...	46,100	3·6 ...	61,800
0·3 ...	11,400	2·0 ...	47,400	3·7 ...	62,400
0·4 ...	14,500	2·1 ...	48,600	3·8 ...	63,000
0·5 ...	17,500	2·2 ...	49,800	3·9 ...	63,600
0·6 ...	20,400	2·3 ...	51,000	4·0 ...	64,200
0·7 ...	23,250	2·4 ...	52,000	4·1 ...	64,800
0·8 ...	26,100	2·5 ...	53,000	4·2 ...	64,500
0·9 ...	28,800	2·6 ...	54,000	4·3 ...	66,000
1·0 ...	31,300	2·7 ...	54,900	4·4 ...	66,600
1·1 ...	33,300	2·8 ...	55,800	4·5 ...	67,200
1·2 ...	35,500	2·9 ...	56,700	4·6 ...	67,800
1·3 ...	37,200	3·0 ...	57,500	4·7 ...	68,300
1·4 ...	38,700	3·1 ...	58,300	4·8 ...	68,800
1·5 ...	40,300	3·2 ...	59,000	4·9 ...	69,300
1·6 ...	41,300	3·3 ...	59,700	5·0 ...	69,800
1·7 ...	43,200	3·4 ...	60,400	5·1 ...	70,300

Supposing, then, that we connect the secondary terminals of an induction coil to the spark balls, and also connect the spark balls by means of an oscillatory circuit consisting of an inductance coil, a condenser or Leyden jar, and an ammeter suitable for measuring high frequency currents made as described; also let us suppose that a strip of paper tape is drawn between the spark balls, as already described, so as to count the number of sparks per second, and let it be assumed also that we have already measured, as described, the capacity of the Leyden jar and the inductance of the circuit, we have then the means for measuring the above five mentioned quantities, C, L, V, J, R, and from these measured quantities we can

* See A. Heydweiller, "On Spark Potentials," *Ann. der Physik* Vol. 48, p. 235 (1898).

deduce the value of others, viz., the frequency n, the decrement δ, the resistance of the circuit R, in ohms, and the number of oscillations per train N, by the following formula:—

$$I_1 = \frac{C}{10^6} V p = V \frac{\sqrt{C/10^6}}{\sqrt{L/10^9}} = V \sqrt{\frac{1{,}000\ C}{L}},$$

$$R = \frac{N L I_1^2}{2 \times 10^3 J^2} \qquad \delta = \frac{R\ 10^9}{4 n L} \qquad M = \frac{4{,}606 \times \delta}{2 \delta},$$

where C the capacity is measured in microfarads, V the charging voltage in volts, L the inductance in centimetres, J the root-mean-square current in amperes, and the resistance R is given in ohms.

Nothing is more astonishing than the large currents which can be given out by condensers of quite moderate size.

We must next consider some facts connected with the decay of oscillations in a train. The reason for this decay is evidently the dissipation of energy from some cause or causes. This dissipation may arise from any or all of the following causes:—

1. The resistance of the inductive circuit.
2. The resistance of the spark.
3. Magnetic hysteresis in the metal of the circuit.
4. Dielectric hysteresis or brush discharge or conduction in the condenser.
5. Radiation of energy from the circuit.

This last cause is generally the most important. In closed or nearly closed oscillatory circuits containing a spark gap, the decay of the oscillations is chiefly due to spark resistance, and, generally speaking, the resistance of the metallic part of a circuit is negligible compared with that of the spark. The decrement per semi-period may be of the order of ·01 or ·001. On the other hand, in open oscillatory circuit, such as an Hertzian radiator or Marconi telegraphic aerial, it is found that the decrement per semi-period is much larger and may have the value ·1 or ·2, and this decay is not due to spark resistance, far less resistance of the wire, but chiefly due to the energy dissipated in the form of electric waves.

Rutherford, Bjerknes and Drude have all devised methods for determining the decrement of electrical oscillations in a circuit. Rutherford's method depends on the principle that if a small bundle of soft iron wires, very fine and short, is magnetised to saturation, and then placed near an oscillatory circuit, it will be de-magnetised proportionately to the strength of the first oscillation, which is in the right direction. Since the oscillations alternately magnetise and de-magnetise the steel, and since the sum of a geometrical progression is proportional to its first term, the integral effect is proportional to the magnitude of the first oscillation. Rutherford, therefore, arranged an apparatus as follows:—Near the oscillatory circuit he placed a very small bundle of steel wires magnetised to saturation, and thereby caused to deflect a magnetometer. He permitted the discharge to pass first in one direction, and then in another, by charging the condenser alternately in opposite directions, and noticed in each case the loss in magnetism of the small magnet. The ratio of these readings gives us the ratio of the first and second oscillations, and a Napierian logarithm of this ratio gives us the value of the decrement, δ. When there is no radiation, it can be shown that the decrement, δ, is equal to the quotient, $R/2L$, where R is the resistance of the spark and circuit, and if the resistance of the metallic part of the circuit is small, we obtain the value of the spark resistance. Rutherford used this method to measure spark resistance, and also to prove that electrical oscillations are confined to the surface of a conductor. If the metallic part of the oscillatory circuit is made of iron wire, the value of the decrement is largely increased by reason of the hysteresis of the iron, but Rutherford found that the thinnest possible deposit of electrolytic copper put on the iron wire brings the decrement back to the same value as if the wire was solid copper.

The second method of obtaining the decrement is due to the Norwegian physicist, Bjerknes. If we connect to the terminals of a condenser an electrostatic voltmeter, the readings of this voltmeter give us the root-mean-square value of the alternating voltage. If we measure the spark length, and determine from that the maximum voltage to which the condenser is charged, we can determine the ratio of this last quantity, V, to the root-mean-square value of the potential, U, and it can easily be shown that the ratio $V/U = 4a = 2R/L$. Hence, from this ratio and the known value of the inductance of the circuit, spark resistance can be determined. A third method, due to both Bjerknes and Drude, is based upon the use of what is called a resonance curve.

Another very important matter is the damping of a Hertzian radiator or Marconi aerial wire by radiation. Hertz gave a well-known formula by which this radiation decrement can be determined, and this can be applied to a wireless telegraph antenna of height h and diameter d. The proof of this formula is long and difficult. It is as follows:—

$$\delta\ r = \frac{\pi^3}{24 \log_\epsilon 2\ h/d} = \frac{0{\cdot}54}{\log_{10} 4\ h/d}.$$

Thus, if the height of an aerial is 50 metres, and the diameter $\frac{1}{10}$th of an inch, we find that the decrement has a value 0·12. This implies that there cannot be much more than a dozen complete oscillations in the case of the ordinary form of the plain aerial.

Another important practical measurement is the determination of the ratio of the energy dissipated in the spark to the energy radiated.

Taking a spark gap, say, five millimetres in length for an ordinary plain aerial, the ratio of the radiation to the resistance decrement is about 10 to 1, and hence the radiation efficiency of the antenna is about 90 per cent. Supposing such an antenna has the capacity, say, of $\frac{1}{5000}$th of a microfarad, and is charged to 15,000 volts, corresponding to a five-millimetre spark gap, 50 times per second, the power given to the aerial is only 1·25 watt, and 90 per cent. of this is about one watt. Such an aerial can affect a suitable receiver 100 miles away. On the other hand, to supply such an aerial would involve the use of an induction coil taking several amperes at 16 volts, and therefore, although the efficiency of the antenna *per se* is comparatively high, there is a considerable loss of energy somewhere else. This loss of energy takes place in the induction coil, and in the arc discharge which accompanies the spark of the induction coil.

(To be continued.)

Institution Notes.—Tramways and Light Railways Association. — A paper on "Improvements in Trucks" was read on December 14th last by Mr. Elmer E. Cook, of the Brush Electrical Engineering Co., in which the author drew attention to the necessity of greater care in the construction of tramcar trucks. Most of the discomfort arising from vibration, pitching, &c., in tramcars is due to cheap and coarsely made underframes, which were originally introduced by American makers, and owing to their low price, not only held the market for a long time against British trucks, but eventually compelled British makers to descend to the same level of workmanship. Most of the defects are due to bad fitting; the truck is as a rule really well-designed as regards proportions and spring distribution, and the materials are good, but the impossibility of accurately machining and fitting the parts together at the ruling prices has resulted in the life of such trucks being limited to about five years. Purchasers are now realising the false economy of cheap and faulty workmanship, and are beginning to insist on the standard of fitting that should have been the rule from the commencement. At the same time, machining should not be carried to a ridiculous length. The radial truck is the greatest improvement made in the last six years, affording a happy compromise between the rigid wheel-base truck and the double-bogie truck, and embodying the best qualities of both without the disadvantages of either. It can be adapted to cars ranging from 14 to 32 ft. in length. With steel-tired wheels, the flanges may be thicker when radial trucks are used, a very important gain. The lessened friction results in reduced wear and tear, and smaller energy consumption. In the short period that the radial truck has been on the market, no fewer than 34 undertakings have ordered them, in some cases giving repeat orders for quantities.

The Junior Institution of Engineers.—On Friday, January 26th, Prof. J. D. Cormack, B.Sc., delivered the honorary member's lecture before this Institution, taking for his subject, "Notes on Boiler Trials." After pointing out the objects and uses of such trials, he set forth the requisite balance-sheet, and indicated the measurements, &c., necessary, and the chief statements to be made. The methods of starting, stopping and conducting tests, and analyses of flue gases followed, and special reference was made to the system of conducting trials recommended by the Committee of the Institution of Civil Engineers. As a supplement to the lecture, a visit was paid on the following afternoon to the engineering laboratories of University College, Gower Street, where Prof. Cormack demonstrated the methods of conducting a boiler trial, one being in progress at the time. All the various observations, measurements and analyses necessary were shown. An interesting collection of calculating machines, &c., was exhibited by Prof. Pearson, and Prof. Fleming's electrical laboratory was also open to inspection. In the mechanical engineering laboratory the whole of the apparatus was on view in operation. Although about 100 visitors were present, the arrangements made by Prof. Cormack were so admirably conceived and carried out, that each member was enabled to see everything to great advantage.

Commercial Testing of Small Motors.

By T. Carter.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Newcastle, December 11th*, 1905.)

In designing a test shop at Messrs. J. H. Holmes & Co.'s works for motors up to 15 B.H.P., the author's chief difficulty was the variety of voltages in vogue, ranging from 100 to 550 volts in some 26 steps. The tests comprise measurements of copper and insulation resistance in the winding shop, inspection on arrival of the motor in the test room, and running tests. The brushes are first set to the neutral position by finding the position in which they are when the machine runs at the same speed in either direction. The full load current can be roughly calculated, but brake tests should be made when possible. The duration of the full load test, when not specified, is taken at one hour for a 1-H.P. frame, increasing to three for 4 and 5 H.P., and to five hours for 10—15 H.P. frames. Temperature measurement, with a thermometer on the surface of the armature, is very unsatisfactory, and the resistance method is much better in the case of the windings, provided that a proper allowance is made in the specification for the higher result obtained in this way. The insulation resistance is best tested by applying an alternating pressure of double the normal voltage, with a minimum of 500 volts; this is obtained from a transformer with variable primary voltage and variable secondary winding. For brake tests, the Walker air dynamometer has been found to give good results, provided that the supply voltage remains constant. The test room is equipped for testing four motors at once, each independently of the rest. Each equipment consists of three standard motor carcases giving 10 B.H.P. at 1,000—1,100 r.p.m., mounted on a bench together with the necessary resistances, ammeter shunts, voltmeter connections, &c. The motor to be tested is fixed on the

same bench, and belted to one of the other machines, the armature of which is selected from stock to suit the supply voltage, which is not always the same. When the voltage of the moto under test is the same as the supply pressure, the machine belted to it is provided with an armature of equal voltage, and runs as a dynamo coupled to the mains, so that the power absorbed is only that which is lost in the field resistances and machines. Generally, however, the power house voltage is not that required for the motor, and in this case the other two machines, belted together, are used as a motor-generator. The arrangements are described in detail in the paper; the cost of a single complete equipment is from £60 to £90, exclusive of the armatures of the three machines.

The author lays stress on the supreme importance of frequently checking the accuracy of the instruments. The 10-B.H.P. frames are large enough to test motors up to 15 B.H.P., except on brake tests, when additional power must be derived from one of the other benches, unless the right voltage can be got from the power house. A separate portable resistance is used for testing small dynamos of low voltage, such as milking boosters.

For testing A.C. motors, two of the machines are replaced by a transformer of variable ratio, and the motor drives the third machine as a dynamo. The A.C. instruments are mounted on a portable table. In conclusion, the author describes a standard terminal base for D.C. motors, by means of which all the necessary combinations of series, shunt and compound connections, for either direction of rotation, can be effected with links, without disturbing the permanent connections.

Recent Advances in Wireless Telegraphy.

By J. Erskine-Murray, D.Sc.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Glasgow, December 12th*, 1905.)

Until quite recently, the system in most general use throughout the world has been Marconi's untuned aerial with earth connection. It is mainly used for distances under 150 miles. The horse-power of a discharge is about 2,000 times that of the current supplied to the induction coil, so that, as the latter takes about 50 watts, the impulse sent out works for a very short time at 200 or 300 H.P. The first impulse is followed by a very short train of rapidly decreasing waves, the first greatly predominating, and actuating any receiver within range.

The methods of tuning now employed depend upon the cumulative effect of a series of small impulses upon a receiver of corresponding period. In 1899 two different messages from separate stations were simultaneously received without confusion by Mr. Marconi at the South Foreland on tuned receivers, and this year Captain Jackson, R.N., received messages on H.M.S. *Vernon*, from a ship whilst transmitting messages to another ship 500 miles away, a marvellous achievement. The essential factor in attaining this result is the transformer or "jigger," the primary of which is connected between the aerial wire and earth, while the secondary circuit, which is tuned to correspond with the transmitting station apparatus, actuates the coherer. By utilising the accumulated energy of a train of waves, the jigger at the same time enormously increased the distance over which transmission could take place; the transmitter has also been improved by the addition of capacity and inductance, enabling it to send out a long train of waves, of which 30 or 40 are of useful amplitude.

One of the first patents for a syntonic system was taken out by Prof. Lodge in 1897; and in 1900 Mr. Marconi invented a system which has great possibilities in regard to exact tuning and reduction in height of the aerial.

Systems in which the frequency of oscillation in the aerial is determined by a persistently oscillating circuit coupled to it, are becoming general. Mr. Marconi maintains communication between England and Italy, over about 1,000 miles, while Prof. Fessenden has telegraphed over 600 miles, and is putting up a station at Machrihanish for trans-Atlantic experiments. The De Forest Co. is also erecting a station for this purpose in Tiree.

Mr. Marconi's aerial for long-distance work consists of a large number of aerial wires arranged like an inverted pyramid, the apex of which is connected to the generating circuit and to earth. The generating system contains a Tesla circuit operated by an alternator. The receiver used for long-distance work by Mr. Marconi, is the magnetic detector designed by himself.

Mr. Fessenden uses a single aerial conductor, consisting of a sheet-iron tube like a factory chimney, about 420 ft. high. His receiver is worked with the barretter, of which the essential feature is a fine platinum point immersed in an electrolyte. The transmitter for trans-Atlantic work is an alternator, with one terminal connected to the aerial and the other to earth. One of Mr. Fessenden's patents describes a system in which two trains of waves of different frequency are transmitted by one aerial, the receiver being actuated only when waves of both frequencies are simultaneously received.

Artom's system of polarised waves, Maskelyne's arched or triangular aerials, Marconi's U-shaped aerial, and Blondel's twin aerial are amongst other patented devices.

In transmission, the maximum potential that can be produced in the receiving apparatus being very small, it is of the first importance that its rate of charge shall be great, so that the current may be as great as possible, though very brief. To this end Hertz's method of obtaining a sudden and energetic discharge—*i.e.*, the spark—is used, but wireless telegraphy does not depend upon the true Hertzian radiation, which is really a dead loss; it is brought about by electrical oscillations between the earth and the aerial. Although no wire is used, the conducting power of the earth is an essential factor in the transmission. An efficient earth connection is therefore indispensable, though it may be an inductive connection without disadvantage. The majority of systems employ a conductive earth connection, but in the Lodge-Muirhead system the connection is inductive.

Theory suggests that the currents received in wireless telegraphy should vary inversely as the square of the distance from the transmitting station; but Duddell and Taylor's measurements between a station at Howth and H.M.T.S. *Monarch* show that the relation is linear. The author suggests that the explanation of the discrepancy is due to the presence of a conductive layer of air between 6 and 60 miles above the earth's surface, the same layer in which auroræ are manifested. As the annular wave between the earth's surface and the surrounding layer in question converges towards the antipodes, the current received should increase after a distance of 6,000 miles has been traversed. But frictional resistance modifies this conclusion, and the fact discovered by Mr. H. Marconi that messages can be received at a greater distance by night than by day, taken together with the ionising effect of the sun's rays during daylight in rendering the lower atmosphere conductive, a quality inimical to the propagation of the waves, is employed in constructing a formula connecting the current received with the angle sub-tended at the centre of the earth by the arc through which a signal is transmitted. The lack of data, however, prevents the complete development of the author's theory.

Electric Winding Considered Practically and Commercially.

By W. C. Mountain.

(*Discussion at the Meeting of the* Institution of Electrical Engineers *at Manchester, January 16th*, 1906.)

The Chairman (Mr. S. L. Pearce) said that up to the present time in this country heavy winding had not made the headway it was expected to. He was afraid that from the figures given by the author in his paper, colliery managers and engineers were not likely to adopt electricity for heavy winding work. Electrical engineers were often charged with one-sidedness, but Mr. Mountain had dealt with the subject of electric winding in a very impartial manner.

Mr. Whitmore (Atherton) considered steam winding more satisfactory than electric winding. Tests on the cross-compound engines at the Atherton Colliery would work out far cheaper than the results given in the paper, if working on full load. One of the latest developments in steam winding was to use the exhaust steam to drive a turbine-generator of 500 or 600 H.P., the energy derived from which could be used for haulage purposes. This was greatly in favour of steam winding.

Mr. Miller said that with the particular type of regenerator mentioned by the previous speaker it did not matter how uneconomical the engine was. In some cases abroad, the energy obtained from the low-pressure steam turbine was 2½ times that given out by the steam engine. To put down electrical plant a saving had to be shown, and the only saving was in coal consumption, but where dust was utilised, there was very little chance for electricity. As the author's figures showed, interest and depreciation practically killed the case for electricity. It appeared to him that the author's figures were all on the top side, and many firms would be willing to take on contracts at less than the figures given in the tables. The author had taken the question from the point of view of a single shaft, but if electric winding was done in a number of pits, it would be quite possible that the result would be altered. The generating plant would be centralised, and management and working expenses would be considerably reduced.

Mr. Peck considered steam winding was more in favour at present owing to the high capital cost of electric plant, though the actual cost of winding the coal was about the same in the two systems.

Mr. Coulston said the author's figures were rather high, and some of them could be considerably reduced.

Mr. Cooper, as an electrical engineer, did not think there was much chance for electric winding, unless it took the form of a continuous wind.

Mr. W. B. Shaw said the steam consumption at the Hulton Colliery worked out to about 25 lb. per H.P. When this figure was compared with the power taken for the electrical drive, the result of the two systems would be about the same, as it was probable that by the time the loss in the string of motors and generators, &c., was taken into account, the efficiency would not be more than 50 per cent. to 60 per cent. The large amount of boiler power in collieries was on account of the sudden heavy draughts of steam required.

Messrs. Brooking, Braun, Wilkinson and Walker also spoke.

Mr. Mountain, in reply, said that the paper was written in the interests of the electrical profession. He mentioned a case of a colliery where £24,000 worth of electrical plant had been put down to do work which could have been done for £4,000 by steam plant. He considered that examples such as that did the trade harm. What had to be done was to reduce the capital cost of the electric system. Referring to the adoption of the "Rateau" turbine as a regenerator, a receiver was used for the exhaust steam, which was afterwards condensed. In a recent test it was found that the turbine was working with 1 lb. pressure and 27 in. vacuum. Two large plants of this type were being put in. An old boiler made a good receiver. As regards single units, that was taking the question on the worst possible lines, but he wanted to start at the bottom. Firms had asked him to quote on these lines lately, and he was

bound to tell them he did not think it would pay. For small collieries, the whole question had to be considered separately in every case.

Mr. Watson, in proposing a vote of thanks to the author, said that the subject was one of great importance to colliery owners and managers, and it did electrical engineers good to have points rubbed into them and to find out how to solve their difficulties.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Art-metal Electric Light Fittings.

With the coming of the compact little 300 pp. catalogue of electrical fittings, issued by The Birmingham Guild of Handicraft, Ltd., mentioned in a previous issue, our attention is compelled to the many meritorious examples of art metalwork therein contained.

Fig. 1.

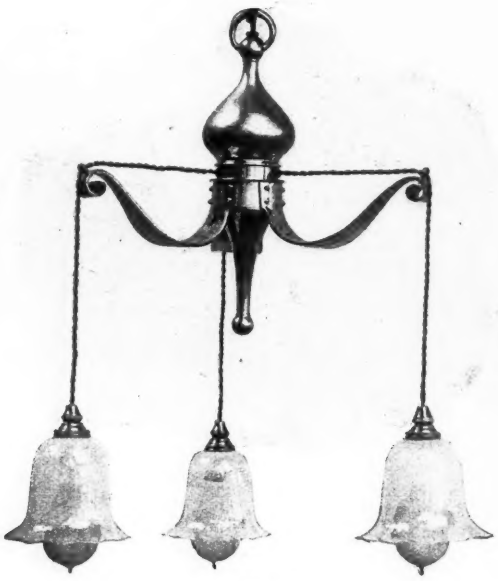


Fig. 2.

Fig. 3.

The company's efforts are directed towards the production of designs founded upon the right use of materials, and they hold the view that no amount of flimsy or elaborate ornamentation can excuse mechanical imperfection, clumsy finish, or unsuitability for practical use. This being so, it is satisfactory to find that the company's productions are meeting with increasing favour, where good work is a *sine quâ non*. The illustrated list above referred to shows a variety of patterns, suited to all ordinary purposes of public and domestic lighting; and what is of more importance to prospective purchasers, all these patterns have been made and tried, and may be seen at the company's showrooms at 7, Newman Street, W., or at the works.

We illustrate herewith three of the company's designs, fig. 1 being a table lamp constructed with a cast brass stand, with hammered copper reflector; fig. 2 representing a brass pendant for chain suspension; and fig. 3 showing a single light pendant with polished brass framework. Space limitations preclude our showing more.

"Harrison" Street Photometer.

There is no need to emphasise the importance of accurate measurements of street illumination. The difficulty has always been, in the first place, the cumbersome nature of photometric methods and apparatus, and in the second, the great skill necessary in order to obtain anything like accurate results.

There has been, in the past, considerable difference of opinion as to whether candle power or illumination measurements should form the basis of comparison, and if the latter, at what angle the receiving screen should be placed. Mr. Haydn T. Harrison, in his recent I.E.E. paper, abstracted in our issue of January 12th, discusses this question very thoroughly, and finally comes to the conclusion that for most purposes an illumination measurement is the most satisfactory, provided this is taken in one direction only, and that, moreover, the angle of the screen is so chosen that the illumination measurements can be readily converted into candle power, should this be required. Mr. Harrison selected an angle of 45° for the screen, which forms a convenient compromise between the horizontal and the vertical.

Mr. Harrison's photometer, which is being put on the market by Messrs. Everett, Edgcumbe & Co., is shown in fig. 4, and diagrammatically in fig. 5, where S L shows the standard lamp which can be moved vertically up and down the case until a balance is obtained. The mirror, M, reflects the light from this lamp on to the rotating screen (F) of the photometer proper. This is of the "Flicker" pattern, so that accurate measurements can be made on lamps of every colour. The screen which receives the illumination to be measured is inclined, as will be seen, at an angle of 45°, and the two illuminated surfaces are alternately presented to the eye of the observer through an eye-piece in the usual way.

The battery feeding the standard lamp consists of four accumulator cells in non-spillable cases which are contained in two compartments of the box and are permanently connected through a small press key to the lamp. When required, the range of the instrument can be increased by the employment of two standard glow lamps of different candle powers. A small voltmeter can be provided when required in order that a check may be kept on the constancy of the lamp voltage, but, as a matter of fact, the cells are of such ample size that it is found that there is practically no variation in the voltage, and the candle power remains constant during many hours' continuous use after the cells have been charged.

A levelling arrangement enables the photometer screen to be set at an angle of exactly 45° with the horizontal, and a lens and scale show at a glance the angle at which the rays from the source of light fall upon the screen.

From a reading taken in this way, representing the illumination

Fig. 4.

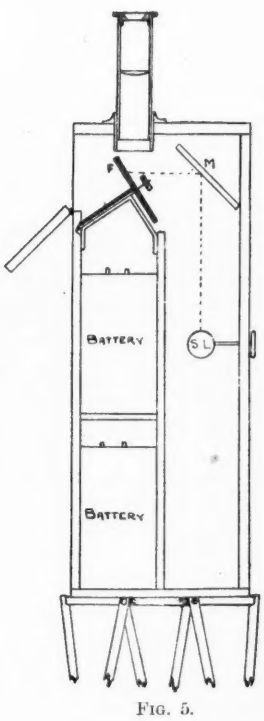


Fig. 5.

on a surface inclined at 45°, either the horizontal or vertical illumination can be at once calculated, or, if required, the actual candle power of the lamp in question.

It is stated that the results obtained with this photometer can be safely relied upon to within 3 per cent. to 5 per cent., according to the brightness of the illumination.

The whole apparatus is, as will be gathered from the figures, absolutely self-contained, and for carrying about the tripod stand folds over flat against the sides of the case and need never be removed from the photometer. The size of the apparatus, when closed, is only 27 in. × 6 in. × 6 in.

A Wireman's Accessory.

In fig. 6 we show the "Simplex" floor opener (Patrick's patent), a cutter whose object is to ease the work of the wireman, plumber or other workman who has to open floors. It is a time-saving

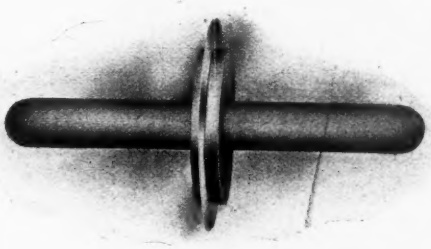


Fig. 6.

device, and in its application it is only necessary to push the blade between the floor boards and work along until sufficient length of tongue has been cut off. Mr. F. Patrick, 14, Oxford Street, Glasgow, is supplying this accessory.

The Secrephone.

The Secrephone Co., of 10, Coleman Street, E.C., have brought out a device which can be attached to the transmitter or mouthpiece of any kind of telephone; it is 3½ in. high, and of simple construction.

Fig. 7.

Its purpose is to enable a conversation to be carried on with perfect privacy, even in the presence of other persons; words can be spoken in an undertone, or even whispered into the apparatus, so as to be perfectly audible to the listener at the receiver, but inaudible to by-standers. It is recommended also for use on trunk lines, or where the speaking is normally defective, as the strength of the sound can, by its means, be greatly increased. Fig. 7 shows the secrephone applied to a hand-combination instrument. It is made of vulcanite, with polished aluminium mountings, and to meet the obvious sanitary objection, due to the condensation of moisture from the breath on the metal, antiseptic absorbent paper linings are supplied, which can be replaced after each conversation.

Electric Lamp Frauds.—At Eccles on January 22nd, Frank Taylor was sentenced to four months' imprisonment for stealing by means of a trick a number of electric lamps. His *modus operandi* was to visit shops and represent that he had mercury vapour lamps for sale. After fitting the lamps, he returned, and, saying that he had fitted the wrong lamps, took them away and sold them to someone else. The lamps he had previously obtained from Mr. Pennington, electrician, of 336, Liverpool Road, Patricroft, by representing that he was employed by a Manchester firm of electrical engineers, who, he said, would pay for them. On this charge he was sentenced to another two months' imprisonment.

THE ELECTRICAL FROISSART CHRONICLES.

(With some apologies to Sir John, and more to "F. C. G.")

By IBID.

VI.—Man and Supper-Man.

It cannot have passed your observation how great an esteem the English folk have for one that is a valiant trencher-man, and that hath an infinite capacity for nourishments. To such a degree is this come that a thin and eager man is of little account among them, for they say "it must be that he doeth work; else were he not so thin." Therefore, is it the custom in their principal Guilds and Clubbes to have a frequent test or examination, to try which are the worthiest in that same Guild, and, when the feast is over, they that have attended are weighed, and such as have gained in consideration are promoted to a higher grade, while they whose doublets hang in frequent folds receive warning that they must amend speedily. All this I have of a credible informant, and, indeed, at divers notable Clubbes have I seen the machine which they use in these examinations. From this is made cleare how many attain unto eminence who can by no man be accused of other qualification. It may seem to you a strange custom, but so have they many.

With the Electriks promotion is not fixed by means of these ordeals, as I have before shown. Notwithstanding, as they will in all things be thought to conform with the uses of the other Guilds, so do they recognise the importance of the Dinner, and hold at least one per annum with all due observance.

Before I tell you of the holding of the ceremonie, I would ye should well comprehend and have fixed in your mind the solemnity of the occasion. For certain persons will have you suppose that in eating their meat together these people have a cheerful intention of fellowship and no more, and perceive not the weighty signification of the matter, which I will presently show you. On account of this solemnity every man doth attire himself in habit of ceremonie, and the white front of a blameless life, which they are not wont to do for a mere learned meeting. To these last ye may enter in tabard chequered, or streaked in any manner that you will, peradventure for that the bodie is not then so much regarded as the head.

It seemeth to me a proper thing that for the Dinner, the method of substitution or representing be applied, or one for many; for it is false to suppose that so great a number of persons, and many young, can duly appreciate so great a meal: wherefore, meeting together in ten or twelve, let them choose one well versed in the gentle art of Dining, to represent them; thus shall due justice be done the occasion. I' faith, there are some would barter the whole menu for an evening spent in dancing or the like frivolity (from which the Count and all his Council preserve us).

Of the dinner itself I will say little: for these matters are ill jested on afterwards, but better before; suffice it that, when we had finished and the verrie lamps had ceased feeding, we were no longer hungry; and the music, playing the triumph of the spirit over the longings of the body, by Meister Tannhäuser, did signify that the body did not, at the time, ask any more.

Now was the time for toasts, and a pleasant incitement to a cheerful thirst; and, indeed, the many steps we had descended to that hall gave me cause to suppose that the cellars were no great way off; and an evening in a cellar is better than a night in the desert.

The first toast given is the King, as I need not tell you; and this very fitly, by the mention of his name only. For the King of this land doth not, by appearing now as music-master, now as preacher, now as painter, seek to give his courtiers fresh matter for flattery: but is content to fill his office of King, and as such is known to his subjects. After followed other toasts to the royal house, given in the same seemly manner. Divers other toasts were after given and replied to, some speaking unto the whole assembly, and others to those only that were near unto them. Some spoke of the great realms which the Electriks should presently subdue, and some of those distant climes where their power

now begins to be felt, and of other matters concerning their increase and welfare. These things troubled me not much, but I remarked with shame that many did admixture with their wine other fluid strongly resembling water, the which custom cannot too strongly be condemned; and this I take to be caused by the admission of so many young men, who will come everywhere, to the discomfort of their elders, despite all that hath been said to them.

About this time a great cloud appeared in the room, dulling the lights, and causing the whole company to seem greatly more numerous than before; and the Hall seemed to me to appear now Moorish, now like in parts to a Tuscan palace, now filled with Alsatian tapestry. So, apprehending some heavy and extended magic, I betook me elsewhere, ere even one of the company had well commenced his second bottle.

These be hospitable fellows, but, ay de mie! what backward drinkers!

Now, as I afterwards found, this cloud which then was formed, presently issuing from the Hall, increased and covered the whole city, yea, as some say, a great part of the land; so that all carts and traffic were held, and the ships stopped in their courses; and the air filled with a thick, harsh vapour. So greate a mischief did this cause, that the guild of the Cloud-Compellers, assembling hastily, did loudly protest against it; whereafter it went away again.

Now, this matter of the obscurity arising after that function of the Electriks will be very plain to you who mark their doings; for, it is said here that such a cloud is caused by the fires in the houses and workshops, and that these must be lessened. Wherefore, to abate them, is not the easy way to remove all fires and furnaces to some place remote from the city, and thence perform all heating, work, and light by magick; which is what the Electricks propose to do. Wherefore are these clouds also on their side.

THE UP-TO-DATE ENGINEER.

By ERNEST C. R. DEEPHOLTS, A.I.E.E.

Having read with great interest the recent and various articles in several of the leading journals of this country on the qualifications necessary to make an up-to-date engineer, I have ventured to write but a few lines on the subject.

Determination, energy and ambition should strike one as the leading characteristics which should be innate in his nature, as well as a love for his profession from the very commencement of his career.

After being educated in a good school or college of repute, till about the age of 17 years, the young man has, or is supposed to have, sufficient knowledge to be able to wend his way to a large institute or technical college, where he may gain both a first-class practical and theoretical training for three or five years, and where the fundaments of engineering, including civil, electrical and mechanical, are combined and well grounded, under the supervision of capable professors, instructors and foremen.

For, as a house with a bad foundation has little chance of standing long, so the engineer with an inferior training will find the process of gaining the top of the ladder and maintaining his position somewhat difficult, though not impossible, at the present time, as "where there's a will there's a way."

Influence and good luck nowadays, although paramount in the success of the rising engineer in obtaining a suitable and good position, yet do not always help in raising the standard of the engineer, if he may so style himself, of the country. It cannot, therefore, be out of place to say that a young man who takes engineering as his profession should take all the opportunities afforded him of thoroughly grounding himself in, and mastering the elements of the same. Consequently I thought it would be interesting to your readers to state briefly, as an example, the training afforded young engineers in one of the leading colleges supported principally by the Government in the Far East.

First Year.—Three hours daily spent in the carpenters' shop, and the remaining four and a half hours in the lecture room or on outside work, where mathematical engineering and other subjects are taught: comprising arithmetic, algebra, trigonometry, mensuration, geometry, estimating houses and building construction, drawing (including plane geometrical and isometrical), levelling with the three up-to-date instruments, and surveying with the prismatic compass and chain.

Second Year.—Hydrostatics, dynamics, physical and electrical science, chemistry in the laboratory, practical and theoretical; surveying with the two principal theodolites on the field with the plane table and Gale's traverse and trigonometrical survey; plan and machine drawing from sketches taken by the student himself; masonry, roads and well-sinking, as well as the estimating of bridges, culverts, &c., together with the usual time allotted for workshop practice in the blacksmith and moulders' shops, comprise the course for the second-year student.

Third Year.—Steam engine practice, applied mechanics and an advanced knowledge in science (both physical and electrical), as well as of general engineering; practical and final test in surveying by the laying out of a road or railway project in some outlying district, besides spending the necessary time in the fitters', turners' and boat-building shops during various periods of the year.

On the completion of this year an opportunity is afforded to the six senior students of that year, in order of merit at the annual examination, of spending some time in the practical working and running of the college electrical plant, as well as the maintenance of the whole installation. The power station, which supplies the current for the buildings and the working of the college workshops, is somewhat small compared with more modern stations, yet it is so designed as to give a clear and apt training to the student by the installation of direct and alternating current generators, as well as a gas, a steam, and an oil engine; so that it is well worth endeavouring to spend an extra six months or a year in order to gain and develop the experience afforded to successful students.

The young man in each year has to obtain a certain percentage in the monthly examinations, as well as to pass in a very strict annual examination in both practical work in the shop and theoretical work at the desk, besides being present at lectures, workshops, &c., for a rather high proportion of the year. Should the student have the bad fortune to fail twice in an annual examination, or not to obtain the necessary percentage, he has no other alternative left him but to give up his technical training in the college for good. This helps to maintain the standard of the engineering profession in the country, as well as to keep up the prestige of the college.

The admirable feature in the examinations held annually is the fact that the preceding year's subjects are included in the tests, thus necessitating a private and careful revision of the subjects already gone through, by the student himself every year. Consequently the final examination of the course is not only obviously long and very tedious—lasting nearly 21 days in a stretch, if not more, sometimes—but it is a test of the worth and stamina of the young engineer, who then passes out to go into the world to gain fresh experience, which is most *essential* in the setting up of an engineer, in order to do credit to himself and his profession in years to come. It may be as well to add that the student, during his college career, has to reside in the quarters provided for him, and has to obey certain rules and regulations made by the principal, under pain of a severe penalty.

Having now to commence a new life, the young engineer endeavours to improve himself by varying his experience in manufacturing works, commercial or office works, and constructional work in the three departments of civil, electrical or mechanical engineering, individually or collectively, for several years, so that he may decide which may be deemed most suitable to himself to specialise.

What, however, is expected of the chief engineer of the present day, is the ability to master, at least, one of the three professions mentioned, as well as have sufficient knowledge in the remaining two, to be able to help him through in his difficulties which must necessarily arise sometimes during his professional career. *Experientia docet.*

The engineer who hopes for success must always be

willing to learn and improve his intellectual abilities by observation and experience, and study to keep himself up to date in engineering practice, for a little learning is a dangerous thing, and one can never know too much. Consequently, the greater the endeavour, the greater will be its reward, and the good engineer is always in demand.

ELECTRICAL POWER IN THE AMERICAN NAVY.

Considerable progress has been made in recent years in the equipment of the auxiliary machinery in the United States Navy, and an informing article in the *American Electrician*, from the pen of L. C. Brooks, gives considerable data as to modern practice. We are indebted to our contemporary for the following particulars, abstracted from the article referred to :—

As regards the generating plant and distribution the latest practice is to have two separate dynamo rooms complete with generators, pumps, condensers, &c., so interconnected, through switches, that in case of accident all the feeders from one dynamo room can be supplied with power from machines in the other room. The feeders terminate in distribution switchboards, located in separate watertight compartments. In unexposed places the cables are run on porcelain insulators, but elsewhere are run in enamelled iron conduit.

The standard voltage for motors is 125, and motors above 4 H.P. are of the multipolar type, the variation of speed permitted between no load and full load is up to 9 per cent. in sizes below 5 H.P., and 6 per cent above this size. In compound-wound motors the series and shunt coils are separate, and no insulating material is used that can be injured by a temperature of 100° C.

The brushes are of carbon, and must not carry more than 30 amps. per sq. in. at the full load. Motors having speed control must always start up on a strong field; arrangements must, therefore, be made to cut out all the shunt resistance on starting up. Where motors are provided with circuit breakers these must be interlocked with the starting lever, so that they cannot be closed except when the starter is in the "off" position. All insulating materials in connection with starters and controlling apparatus must be non-combustible, non-absorbent and incapable of damage by moisture or heating to a temperature 150° C. All starting resistances to be capable of carrying 50 per cent. overload for one minute and 100 per cent. overload for 20 seconds.

The rheostats to be so constructed as not to rise in temperature more than 100° C. above the air when carrying full load current. The temperature rise specified for the motors after a full load run for a specified time is, for the commutator and field windings, 40° C. for open type and 50° C. for enclosed type motors, and for the armature 35° and 45° C. respectively.

Turret Turning Gear.—Each turret is operated by means of two enclosed shunt wound motors through spur and worm gear, the worm wheel having a vertical shaft upon which is mounted a pinion which gears into the rack on the turret. A friction clutch is interposed in the line of gear to prevent sudden shock on the motor due to sudden stopping of the turret, or to the impact of gun firing, or being struck by shot. Automatic stops knock off the controller to the "off" position when the turret reaches its limit in either direction. The requirements are that the turret shall turn at a minimum speed of one complete revolution per hour and a maximum speed of one revolution per minute, a speed range of 60/1. This wide range is obtained by means of the Ward-Leonard system of speed control.

Gun Lifting and Loading Gear.—For lifting a 12-in. gun an enclosed shunt wound motor is geared up to a revolving screw which raises or lowers a nut cross-head which operates the gun through connecting rods.

For 8-in. guns the motor is geared through a pair of spur gears, a pair of mitres and a worm and worm wheel, the latter driving a pinion which engages a segment of the rack fixed in the gun carriage. These motors are also operated on the Ward-Leonard system of speed control through a reversing rheostat. A small motor-generator for the purpose is located near the gun, this being, of course, driven from the main generators.

The rammer for loading the guns consists of a telescopic tube operated through spur and chain gearing by an enclosed series wound motor. A slipping clutch is fitted in the main gear to prevent damage when the shell is seated in the gun.

Ventilation.—In order to reduce to a minimum the piercing of water-tight bulkheads a large number of small fans are used, thus reducing the number of automatic valves and piping which would otherwise be necessary if large fans and ventilating ducts were used. It is found by experiment that the friction of a 20 ft. length of pipe or a 90° bend reduces the velocity of air by 10 per cent., allowance for this is therefore made in designing the scheme and size of piping and outlets. Natural exhausts of twice the area of the supply are fitted in all magazines.

All spaces are ventilated on the plenum system, except the lavatories, which are ventilated by exhaust. The fans are installed to give the following changes of air when running at one ounce pressure: Quarters inside of armour, once in 4 minutes; quarters outside armour, once in 12 minutes; store-rooms once in 8 minutes; lavatories once in 6 minutes; evaporator rooms once in 2½ minutes; engine and steering gear rooms once in 2 minutes; air spaces over boilers and around magazines once in 2 minutes; dynamo rooms once in ¾ minute.

The fans are required to give a specified amount of air at one ounce pressure, and to be capable of an increase in power and speed to work up to 1½ ounce pressure with restricted delivery.

Boat Cranes.—The power for operating the cranes is furnished by two series-wound motors, one for hoisting the load and one for rotating the crane. The hoisting motor drives through a pair of spur gears a worm and vertical worm wheel, which is secured to the hoisting drum. The rotating or slewing motor drives through a pair of spur gears, a worm and horizontal worm wheel, rack and pinion. The commutator ends of the motor shaft are fitted with magnetic brakes of the disk type with sufficient power to hold the full load of the crane. The motors are operated by means of a two-cylinder controller, one cylinder for each motor, the circuit breakers being mounted between the cylinders. An important part of the boat crane equipment is an automatic mechanical brake which is fitted on the worm shaft of the hoisting gear. This brake is so constructed as to absorb no power when hoisting the load, but must so control the load when lowering that the rope speed cannot exceed twice the hoisting speed.

Brakes of the Weston type (both disk and cone) have given satisfactory results.

The connections of the motor are such that the armature is connected in parallel with a part of the resistance, except in the full speed positions. This arrangement permits of very gradual increase of the speed, making small movements of the load possible. With the mechanical parts properly fitted, a 16-ton load may be moved a distance of ⅛ in., and a total gearing efficiency of 65 per cent. may be obtained.

Deck Winches.—A number of deck winches are used for coaling, and these are operated by an enclosed series or compound motor through a pair of spur gears driving a shaft, on the end of which the winch head is secured, the shaft being controlled by means of a foot band brake. The controller is of the single cylinder type, designed for operating in one direction, and a reversing switch is provided for operating in the opposite direction when necessary. The winches are designed to hoist 2,200 lb. at 300 ft. per minute, and a service test of half-an-hour at full load and speed is required. The winches located on the main deck are fitted with a compound gear, designed for hoisting 22,000 lb. at 30 ft. per minute, which may be thrown in by means of clutches, when it is desired to use these for hoisting anchors or other heavy work. A gear efficiency of 70 per cent. is obtained, including loss in friction in the pulley blocks.

Ammunition Hoists.—Three types of electrically operated hoists are used for hoisting ammunition from the magazines, namely, turret, chain, and whip hoists.

The turret hoists each consist of a car with compartments for a charge of shell and powder for one fire of the gun, and run from the handling room to the loading position of

the gun on a structural steel track. An enclosed motor drives the drum shaft through a pair of spur gears, and is located in the pan of the turret or in the central girder. The controller, rheostats, circuit breaker, and line switch are located near the gun, so that the operator has full view of the car passing up and down the track. The motor shaft is fitted with a magnetic disk brake which sets at the "off" position of the controller, and is of sufficient power to hold the full load. A safety device on the car grips the track in the event of the rope breaking. When lowering, the armature is shunted by part of the rheostat, and acts therefore as a magnetic brake.

The total weight of ammunition and car is 2,970 lb. for 12-in. hoists, and 950 lb. for 8-in. hoists. A gearing efficiency of 65 per cent. is obtained.

Chain hoists are used for raising the ammunition for the small guns. These are each operated by means of an enclosed shunt-wound motor through two pairs of spur gear on to a lower sprocket shaft, which then drives up to the sprocket shaft at the head of the hoist by endless steel chains carrying the ammunition carriages. The head of the hoist is provided with a delivery table and safety catch to prevent a charge from slipping back into the hoist, and a magnetic cone brake prevents a charge from dropping, should the current fail. The motor pinion is fitted with a disk type friction clutch, which acts in the event of jamming. The hoists can also be worked by hand gear. The ammunition hoisted, weighs from 73 to 134 lb., and travels at an average speed of 90 ft. per minute. An efficiency of 70 per cent. is obtained in the gear.

Whip hoists are used for raising ammunition from the weather deck, where it is delivered by chain hoists, to the small guns in the military tops on the masts. The drum shafts are driven through a pair of spur gears by an enclosed shunt-wound motor, the shaft of which is fitted with a magnetic cone brake, the speed control being similar to that of the turret hoists. The rope speed is about 240 ft. per minute, and the overall efficiency of the gearing, including rope friction on the sheaves, is 60 per cent.

Pumps.—Pumps of the centrifugal type are used for the drainage system, and of the three-plunger type with spring valves for delivering fresh water from the storage tanks in the hold to the reservoir tank on the bridge-deck. These pumps are driven by direct-coupled enclosed shunt-wound motors.

Power Doors.—The more important hatches and doors through the principal water-tight bulkheads and protective deck are operated by power, being of the vertical or horizontal sliding type as local conditions require. An enclosed compound-wound motor drives a worm through two pairs of spur gears; the worm engages a rack on the door, making the movement of the door positive in either direction. The door operates like an ordinary gate valve, and is made water-tight when fully closed by wedges on the door plate setting up against rollers in the door frame. When fully closed and locked, a button on the door plate engages a contact box on the door frame, closing a secondary circuit which lights a lamp in the emergency station in the pilot house from which the entire system of doors and hatches is operated automatically. In order to avoid a sudden rush of current on the feeders, the emergency station starts the doors at intervals of three seconds.

The power for the laundry machinery and the workshop is taken from a countershaft driven at constant speed through a pair of spur gears by an enclosed shunt-wound motor. The air compressors used for supplying air for torpedo tubes, smoke ejectors, pneumatic tools, &c., are also operated by enclosed shunt-wound constant speed motors.

Bennis Stokers for Shoreditch.—The Shoreditch B.C. Electricity Department has placed an order with the Stirling Boiler Co. which stipulates for the supply by MESSRS. ED. BENNIS AND CO., LTD., Little Hulton, Bolton, of eight patent chain-grate stokers, Bennis-Miller-Bennett type, fitted with the "Bennis" patent light load damper, and the necessary shafting, gearing and accessories. The stokers are to be used in connection with both Stirling and Babcock & Wilcox water-tube boilers.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

24,452A/05. "Improvements in switches for use with incandescent electric lamps." F. HARRISON. (Date applied for under Rule 5 of the Patents Rules, 1905, November 27th, 1905.) January 17th. (Complete.)

10,400A/05. "Improvements relating to combined fire alarm and telephone systems." I. B BIRNBAUM and F. G. BELL. (Date applied for under Rule 5 of the Patents Rules, 1905, October 20th, 1905.) January 18th. (Complete.)

1,019. "Improvements in or relating to electric furnaces." G. GIN. January 15th. (Complete.)

1,065. "Improvements relating to electric batteries." M. WILDERMAN. January 15th.

1,068. "Improved means for preventing overheating of electrical machinery." The Hon. C. A. PARSONS. January 15th.

1,097. "Improvements relating to electric motors working with single-phase alternating currents." The RHODES ELECTRICAL MANUFACTURING CO., LTD., and F. CREEDY. January 15th.

1,099. "A means for controlling the contact lever of electrical igniting apparatus for explosion motors." E. EISEMANN. January 15th. (Complete.)

1,114. "A new or improved electrical leakage discharger and indicator for use on electric tramcars and the like." H. M. ANNING. January 15th.

1,115. "Improvements in and relating to electric meters." THE BRITISH THOMSON-HOUSTON CO., LTD., and A. J. MARTIN. January 15th.

1,116. "Improvements in and relating to vapour-electric apparatus." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) January 15th.

1,151. "Improvements in and connected with battery-testing apparatus in pocket size." H. OPPENHEIMER. (Aktien-Gesellschaft Mix & Genest, Germany.) January 16th.

1,152. "Improvements in electric power horizontal log band-saw machines." A. RANSOME and A. LAVO. January 16th.

1,161. "Improvements in or relating to trolley switches or cross-over devices such as used in overhead conductors of electric tramways and railways." E. CENTONZE. January 16th.

1,218. "Improved electrically-indicating target." G. HUNTER. January 16th.

1,221. "Improvements in and relating to the indication, measuring and recording of electric currents." R. ARNO. (Date applied for under Patents Act, 1901, January 17th, 1905, being date of application in Italy.) January 16th. (Complete.)

1,230. "Improvements in and relating to mechanism for use in electrically lubricating the shafts of machinery and the like." H. FOWKES. January 17th.

1,242. "Improvements in certain parts of electric switches." VERITYS, LTD., and A. E. GOTT. January 17th. (Complete.)

1,259. "An electrical switch for increasing or decreasing the number of lamps or other appliances in use." C. J. TURNER. January 17th.

1,307. "Improvements in and relating to electric arc lamps." THE BRITISH THOMSON-HOUSTON CO., LTD., and E. J. MURPHY. January 17th.

1,308. "Improvements in and relating to electric arc lamps." THE BRITISH THOMSON-HOUSTON CO., LTD., and E. J. MURPHY. January 17th.

1,309. "Improvements in and relating to electric safety spark gap devices." THE BRITISH THOMSON-HOUSTON CO., LTD. (Allgemeine Elektricitäts-Gesellschaft, Germany.) January 17th.

1,316. "Improvements in or relating to electric or pneumatic bell-push mechanism." F. A. JUHEL. January 17th.

1,389. "Improvements in electric cables." J. E. KINGSBURY. (The Western Electric Co., United States.) January 18th.

1,394. "Improvements relating to electric couplings." J. NEYRET. (Date applied for under Patents Act, 1901, January 31st, 1905, being date of application in France.) January 18th. (Complete.)

1,396. "Improvements in or relating to secondary batteries." A. P. STROHMENGER. January 18th.

1,404. "Improvements in or relating to insulators for the conductor or 'live' rails of electric railways and the like." H. A. DUPRE. January 18th.

1,410. "Improvements in arc lamps." M. FORTUNY. (Date applied for under Patents Act, 1901, January 25th, 1905, being date of application in France.) January 18th. (Complete.)

1,453. "Improvements in ears or supports for overhead trolley wires." F. MORRIS. January 19th.

1,469. "A combination of apparatus worked in conjunction with any time indicator for the purpose of calling attention electrically and automatically at any desired time at a distance from the said time indicator." G. PATTISON. January 19th.

1,481. "Improvements in alternating current electric motors." W. M. BRADSHAW. (Date applied for under Patents Act, 1901, February 1st, 1905, being date of application in United States.) January 19th. (Complete.)

1,487. "Improvements in or relating to electricity meters." O. T. BLATHY. January 19th. (Complete.)

1,507. "Improvements in magneto-electric ignition apparatus." F. R. SIMMS and R. BOSCH. January 19th. (Complete.)

1,509. "Improvements in or relating to apparatus for generating and applying electricity for lighting purposes on railway and other vehicles." F. J. BEAUMONT, W. M. STILL and M. W. W. MACKIE. January 19th.

1,541. "Improvements in or relating to brush-holders for dynamo-electric machines." J. T. WESTWOOD and W. L. JONES. January 20th.

1,564. "Improvements in and relating to signalling systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) January 20th.

1,569. "Improvements relating to accumulators." M. WILDERMAN. January 20th. (Complete.)

1,576. "Improvements in or connected with electric secondary batteries." W. H. FELLOWS, E. T. PICKUP and W. TICE. January 20th.

1,578. "Improvements in the electrolytic manufacture of copper wire, strip or the like." S. O. COWPER-COLES. January 20th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

ELECTRICAL REGULATING, TESTING AND MEASURING APPARATUS. R. W. Paul and G. W. Harris. 7,972. April 4th.

AUTOMATIC CUT-OFFS OR INTERRUPTERS FOR ELECTRIC CURRENT. D. C. Canizares. (Date applied for under International Convention, June 30th, 1904.) 12,432. June 15th.

ELECTRIC CONTROLLING ARRANGEMENTS AND CIRCUITS FOR TRAINS ON THE MULTIPLE UNIT SYSTEM. British Thomson-Houston Co., Ltd. (General Electric Co.) 12,594. June 17th.

JUMP SPARK APPARATUS FOR IGNITION PURPOSES IN GAS ENGINES AND THE LIKE. A. J. Boult. (Mueller.) 13,148.

The British
Westinghouse
Electric and Manufacturing Company, Limited

London and Manchester.

Telephones:—London: 3261 and 2476 Gerrard. Manchester: 5222 and 4109 Central.
Telegrams:—"Multiphase," London. "Westinghouse," Manchester. *Codes:*—Westinghouse and Lieber.

Bulletin, No. 9. February, 1906.

Gas-Engines

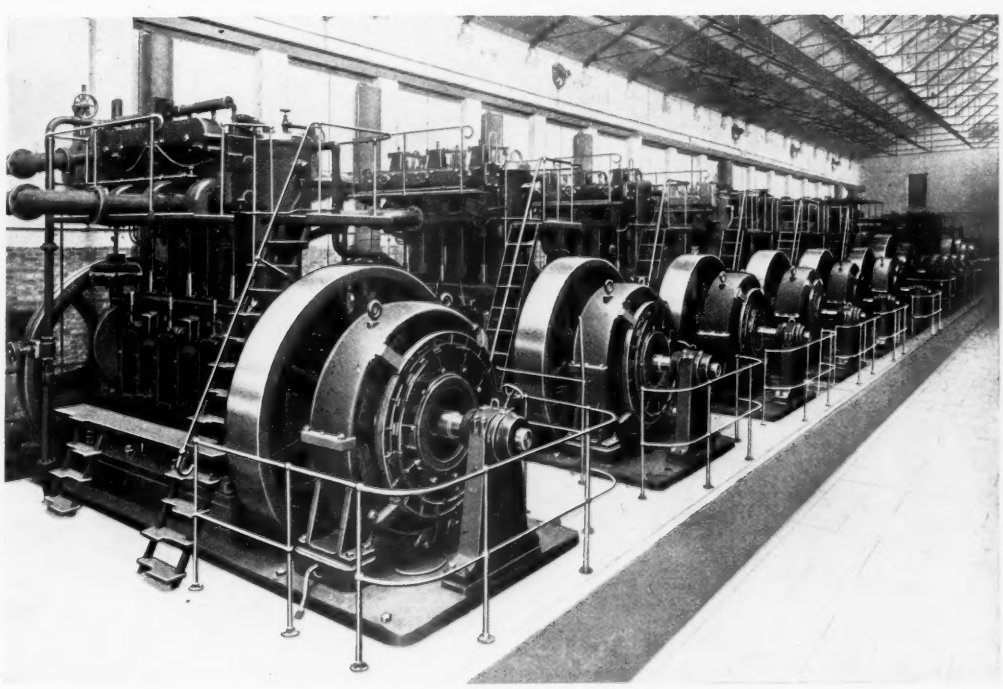


Fig. 1.—Thirteen Westinghouse Producer Gas-Engines direct-coupled to Direct-current Dynamos. Aggregate capacity nearly 2650 B.H.P. *(Walthamstow Urban District Council.)*

Keep for Reference.

The British Westinghouse Electric & Mfg. Co., Ltd.

Parallel Operation of Direct-Coupled Alternators guaranteed.

IT is beginning to be generally acknowledged that the Westinghouse Gas-Engine is equal, and in many cases superior, to the most efficient type of steam-engine.

Of simple construction, with few moving parts, and substantially built throughout, it is a thoroughly reliable engine.

The crank-case is totally enclosed, and the engine is built on the vertical plan, which gives it a very compact and business-like appearance.

The lubrication is automatic, ensuring a liberal quantity of oil being distributed to all the main moving parts.

Westinghouse Gas-Engines are suitable for operation on illuminating, producer, blast-furnace, or coke-oven gas. They are built both single- and double-acting; the sizes of the former type ranging from 10 to 250 B.H.P., while the latter are built in sizes from 250 B.H.P. upwards.

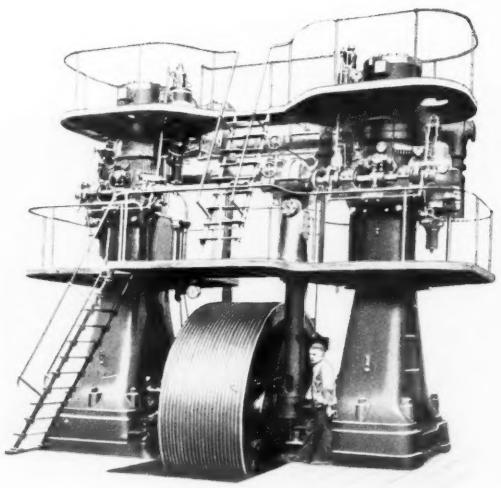


Fig. 2.—540 B.H.P. Westinghouse Double-Acting Producer Gas-Engine. *(Hollins Mill Co., Marple.)*

The following are a few of the prominent features of the Westinghouse Gas-Engine. Full descriptive particulars of the Company's various types of engines and of their principal parts, together with detailed information as to their working, are given in the larger publication: *Westinghouse Gas-Engines*, which will be sent, post free, on application. The Company will at all times be pleased to furnish any additional particulars required and to enter into correspondence with intending purchasers.

Speed Regulation

The Westinghouse Gas-Engine operates on the 4-cycle system with a throttle controlling the amount of mixture admitted to the cylinders. By this means the strength of the explosion is adapted exactly to the power required. The sequence of the explosions is regular, and the turning movement is quite as uniform as is obtainable with any type of reciprocating steam engine.

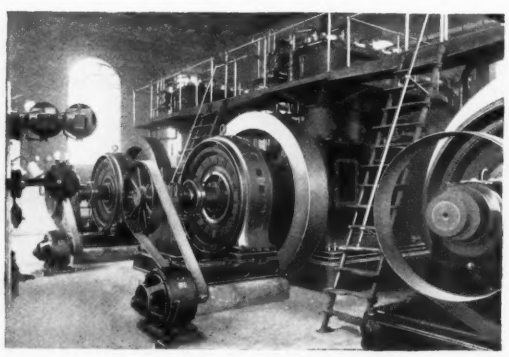


Fig. 3.—Four 250 B.H.P. Westinghouse Gas-Engines direct-coupled to Westinghouse 3-phase Alternating-Current Generators. *(London Paper Mills, Dartford.)*

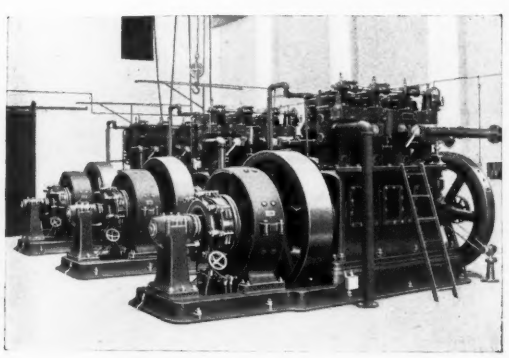


Fig. 4.—Three 100 B.H.P. Westinghouse Gas-Engines direct-coupled to Direct-Current Dynamos. *(Limerick Urban District Council.)*

Prompt Delivery of Standard Sizes.

The British Westinghouse Electric & Mfg. Co., Ltd.

Parallel Operation of Direct-Coupled Alternators guaranteed.

Parallel Running

As a natural consequence of the above regulation of the engine, direct-connected alternators can be run in parallel without any trouble. A gas-driven plant of this description is illustrated in Fig. 3.

Smooth Running

The Westinghouse Gas-Engine is noted for its smooth running and its freedom from vibration. The latter, being a very important quality in gas-engines forming a part of almost every modern plant, has received special attention.

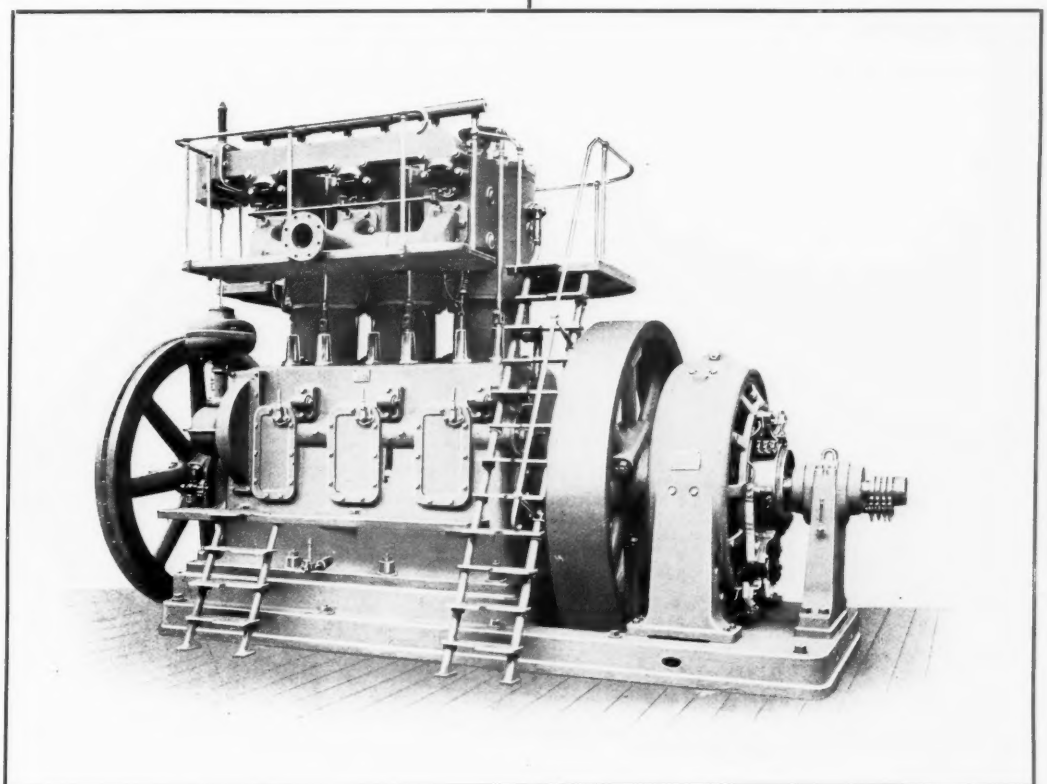


Fig. 5.—220 B.H.P. Westinghouse Producer Gas-Engine coupled to a Westinghouse 3-wire Direct-Current Dynamo.
(Messrs. Henley's Telegraph Works, Co., Ltd.)

Ignition

The ignition is effected by a high-tension electric spark. There are no moving contacts in the combustion chamber, and the engine is under perfect control. The point of ignition is variable at the will of the operator.

Quick Starting

The engine is started by means of compressed air, and this operation can be accomplished by one man in less than a minute.

Quiet Exhaust.

The Westinghouse Gas-Engine has a quiet exhaust, and is, consequently, eminently suitable for operation in places where noise must be avoided, such as private installations or electric-lighting plants for city or residential districts.

Accessibility.

Owing to the simplicity of the design all parts are accessible, and can be readily examined.

Prompt delivery of Standard Sizes.

Prompt Delivery of Standard Sizes.

The British Westinghouse Electric & Mfg. Co., Ltd.

Parallel Operation of Direct-Coupled Alternators guaranteed.

Progress.

The British Westinghouse Company is able to report a continuous growth of its business in this class of prime-mover. It now numbers amongst its clients, having from a single to several units in constant service, many of the older staple industries of this country. These include iron works and shipbuilding yards; cotton mills—the only cotton mills in the kingdom, it is believed, using the gas-engine; textile machine-makers; small arms factory; paper mills; brick and tile makers; cocoa and chocolate factories; pumping stations; boot factories; and gas companies.

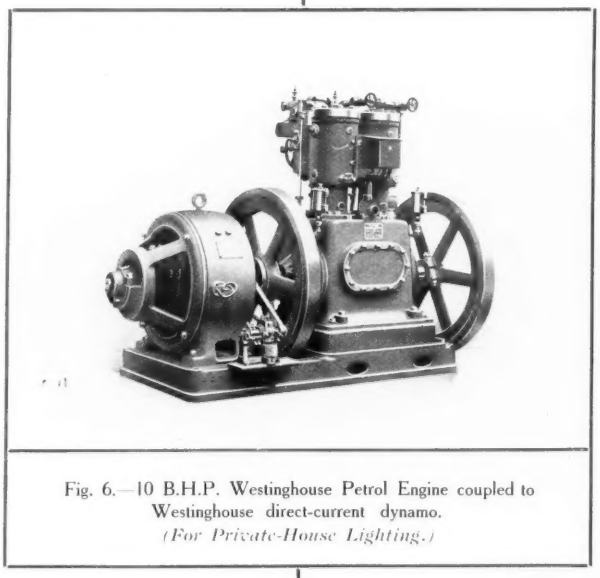


Fig. 6.—10 B.H.P. Westinghouse Petrol Engine coupled to Westinghouse direct-current dynamo.
(For Private-House Lighting.)

This list takes no account of installations carried out for a very important, though modern class of customer, such as urban district councils. Modern undertakings naturally direct their choice towards the most efficient machinery for the work they require to do, and, so far, their decisions have been in the direction of the gas engine. It is, however, upon the waking up of the older industries to the advantages offered by the gas-engine that confidence in its future can best be based. The parallel operation of direct-coupled alternators is guaranteed. Installations of these, which the British Westinghouse Company has carried out from time to time, have given perfect satisfaction.

A few typical Installations.

Among the many successful gas-engine installations which the British Westinghouse Company have carried out, may be mentioned the following:—

Walthamstow:—There are thirteen Westinghouse Producer Gas-Engines installed in the power-house of the Walthamstow Urban District Council, each connected to a direct-current dynamo. This is the largest power-house in the United Kingdom where gas-engines are exclusively used for lighting and traction purposes. Aggregate capacity nearly 2650 B.H.P.

London Paper Mills, Dartford:—This installation comprises four 3-cylinder 250 B.H.P. Westinghouse Gas-Engines direct-coupled to Westinghouse Three-Phase Alternating-Current Generators. The alternators are run in parallel, and operate continuously throughout the week. (Fig. 3.)

Limerick:—Three 100 B.H.P. Westinghouse Gas-Engines direct-coupled to continuous current generators are in operation here. This is another instance of the use of Westinghouse Gas Engines in a public electricity supply station. (Fig. 4).

Railway Companies:—Four of the most important railway companies of Great Britain have installed Westinghouse Gas-Engines, the plants aggregating more than 3000 B.H.P.

The British Westinghouse Electric & Manufacturing Co., Ltd.

Head Offices:
LONDON: Westinghouse Building, Norfolk Street, Strand, W.C.

Branch Offices:
BELFAST: 7, Donegal Square.
BIRMINGHAM: Central House, New Street.
CARDIFF: "South Wales Daily News" Buildings, 102, St. Mary Street.
GLASGOW: 65, Renfield Street.
MANCHESTER: 5, Cross Street.
NEWCASTLE-ON-TYNE: Collingwood Buildings, Collingwood Street.
SHEFFIELD: Market Place Buildings.

Works:
MANCHESTER: Trafford Park.

Agents:
For Australia, New Zealand, and Tasmania.
DUNEDIN: Noyes Bros. 1, Crawford Street.
MELBOURNE: Noyes Bros., 15 and 17 Queen Street.
SYDNEY: Noyes Bros., 109, Pitt Street.
For South Africa.
JOHANNESBURG, CAPE TOWN, and DURBAN.
For India, Upper and Lower Burmah, and Ceylon.
CALCUTTA: Jessop & Co., Ltd., 93, Clive Street.

Note.—Please write to any of the above offices for our new fully detailed publication: *Westinghouse Gas Engines*, post free on application.

Printed by The Westinghouse Companies' Publishing Department.